AN ILLUSTRATED GUIDE TO THE

MODERN SOVIET AIR FORCE

In-depth analysis of more than 40 aircraft plus variants

160 fact-packed pages

100 photographs, many in rare color

Over 60 superb color drawings

70 line drawings

Bill Gunston

AN ILLUSTRATED GUIDE TO THE

MODERN SOVIET AIR FORCE

a Salamander book

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NEW YORK

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Bill Gunston

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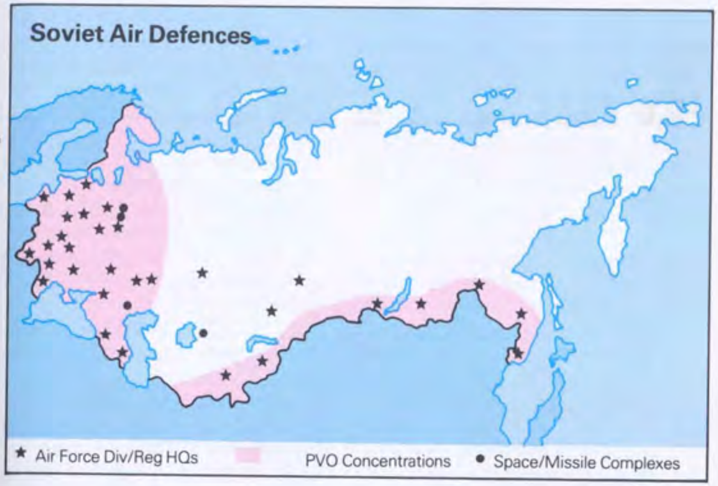
Organisation of the Soviet Aviation Forces

SALAMANDER Books has previously published three titles which deal with the Soviet air forces: *The Soviet War Machine, Soviet Air Power* and the relevant part of *Air Forces of the World*. In this new book an up-to-date account is given of the aircraft flown by the Soviet Union's military services, with the exception of helicopters which are covered in a companion volume, *Military Helicopters*. Every word of this book has been written since December 1981.

The structure of the Soviet Union's military force is unique. The main 'air force', the VVS *(Voyenno-Vozdushnye Sily)*, has two principal operating arms. By far the largest in numerical terms is the FA (*Frontovaya Aviatsiya,* frontal aviation), which provides all the tactical airpower. The DA (*Dalnya Aviatsiya,* long-range aviation) provides strategic firepower. A third arm, the VTA *(Voyenno-transportnaya aviatsiya)*, provides airlift capability for all requirements of all services, while the GVF (civil air fleet, Aeroflot) can provide instant back-up when necessary.

By far the most terrifying part of the national arsenal, the global nuclear missile forces, are a separate branch of the armed forces entirely (Strategic Rocket Troops). So, too, is defence against air attack; the PVO *(Protivo-vozdushnaya Oborona)* Strany is by far the largest air-defence force in the world, with more than 5,000 early-warning and height-finder radars, over 2,500 manned interceptors and some 50,000 SAMs (surface-to-air missiles) at over 1,000 major missile sites. Another independent arm is the AVMF (*Aviatsiya Voyenno-morskovo Flota,* aviation of the navy), whose powerful regiments are an integral part of the four Fleets into which the VMF is divided.

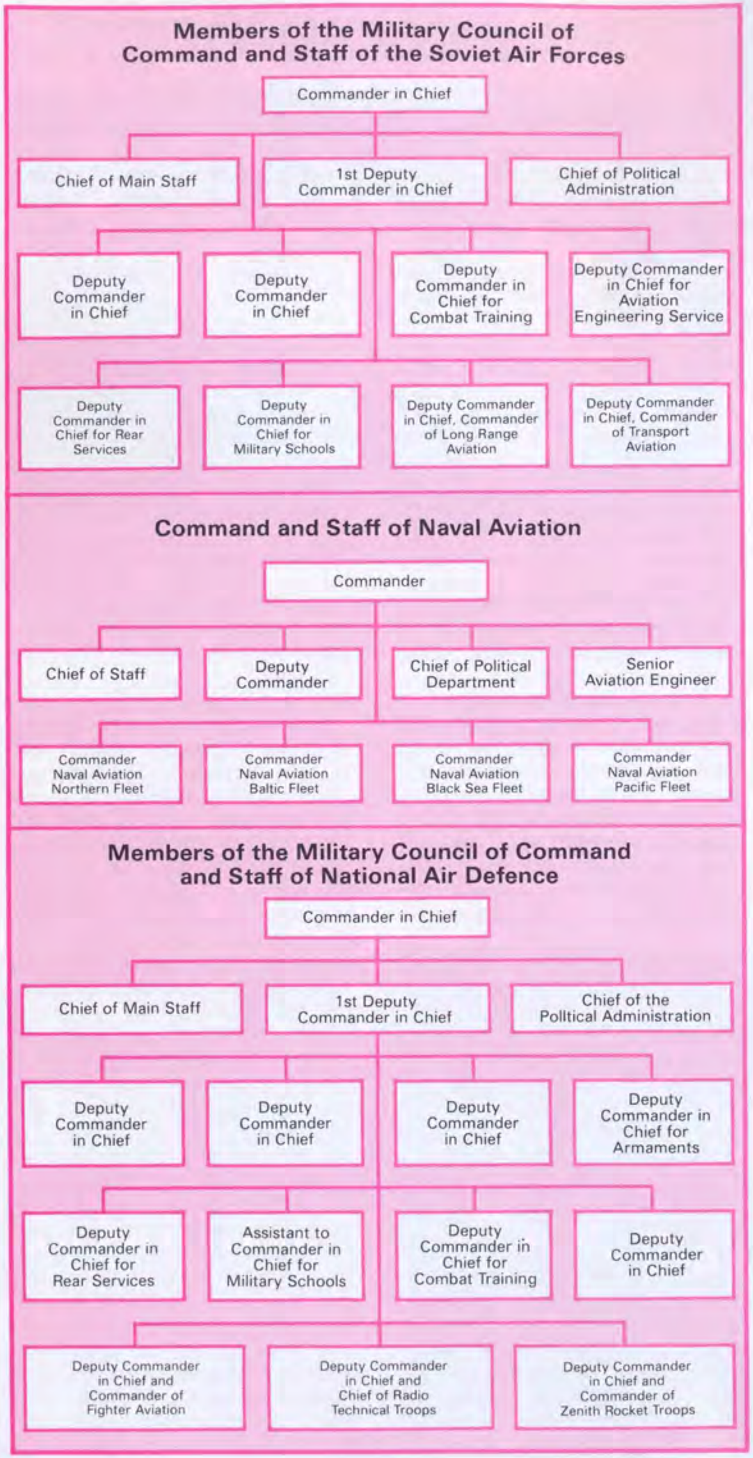


Above: The PVO (air defence forces) are deployed to guard what the Soviet Union regards as the vulnerable parts of its 8,648,000 square miles (22.4 million km²): all Russia and the Chinese frontier.

Though there thus appear to be a lot of 'air forces', in fact overall control is tight, centralized and apparently extremely efficient. This is certainly the case with aircraft procurement, where plans are made on a national basis as far ahead as possible, and co-ordinated between all branches of the armed forces and GVF to minimize the number of distinct types of aircraft and engines. Moreover, the Russians do not wastefully produce unnecessary fresh designs if future requirements can be met by improving an existing machine. There is little doubt that, had the Canberra and Hunter been designed in the Soviet Union, their development would have continued up to the present day. The 1982 variants would not have had much in common with the 1951 types but they would be useful and cost/effective, and the policy has had great benefits in reducing the effort and costs of training, the availability of airpower in harsh environments, and the provisioning of spares.

In fact, not only is the number of types of aircraft in this book remarkably small but many of them are almost the same aerodynamic shape interpreted by different OKBs (design offices). ▶

Left: The West has no aircraft in the class of the Tu-22M 'Backfire', here photographed by the Swedish Air Force.



▶For example, in the late 1940s TsAGI (Central Aerodynamic and Hydrodynamic Institute) perfected a layout for an all-weather interceptor with a swept wing in the mid-position on a fuselage housing a VK-1 engine in the front portion, with the jet pipe under the belly, plus a second VK-1 in the rear fuselage exhausting at the tail. This exact configuration was built and flown by the La, MiG and Su OKBs, though none of the designs was adopted for production. In 1954-55 TsAGI perfected the tailed delta to complement the previously developed acute 57° to 60° swept wing, and numerous examples of both families were built by MiG and Su, several being produced in quantity. In the early 1960s two further layouts were devised with variable-sweep 'swing wings'. One was for application to existing aircraft, with hinged outer portions of wing pivoted to a large and almost unchanged centre section; this resulted in the Su-17 family and the Tu-22M. The other was for a 'clean sheet of paper' aircraft, with just a small inboard glove carrying large pivoting wings, and this was used for the MiG-23 family and Su-24.

Aircraft designations

Lacking the names of separate companies, Soviet aircraft used to be indentified by function, by such designations as TB-3 (meaning heavy bomber, type 3). From 1941 the designations were changed to the abbreviated surname of the designer, such as La-5 (S.A. Lavochkin, design no. 5 for series production). Usually the OKB number was not the same as the official service number for military aircraft, so that, for example, A.N. Tupolev's Tu-88 was adopted by the VVS as the Tu-16. For military aircraft, fighters were given odd numbers and all other types even numbers. For civil aircraft, the OKB number was usually adhered to (so that the Tu-154 is known as such in Aeroflot service). To confuse matters further, the Western (NATO) countries often did not know either designation, and so assigned a series of reporting names. Bombers were given names beginning with B, so that the Tu-16 (Tu-88) was called 'Badger'. Fighters were given names beginning with F, transports names beginning with C and all other types names beginning with M (miscellaneous).

Today most of the famous pioneer designers are dead, two notable exceptions being A.S. Yakovlev (senior designer in the Soviet Union, invited to sit in on every new-design conference and offer critical comment) and O.K. Antonov. The other OKBs have in general chosen to retain their well-known title, just as have such famous companies as Boeing, Cessna and Douglas. For this reason the first line of each entry in this book variously calls the originating office 'The OKB of Mikoyan and Guryevich' (for example) or 'The OKB named for Mikoyan and Guryevich'; in other words, same office but at different periods of time.

The designation MiG is certainly known to more humans than the appellation of any other aircraft. This is because, while names such as Boeing are familiar in about half the world's countries, MiG is familiar in most of the remainder as well. For various reasons the Soviet Union has often exported military hardware at what appears to be less than the true cost of producing it, and MiGs of various kinds have fired guns and dropped bombs in almost every shooting war, or border conflict, of the past 20 years. MiGs, like other Soviet aircraft, tend to be designed with the first priority on meeting reasonable mission parameters when flown by ordinary pilots and looked after by ordinary servicing personnel. This means they must fly well, without vices, be tough and simple to maintain, even in a very adverse and technically austere environment. Whenever practical, it must be possible to operate▶

safely from a rough unpaved airstrip no more than a kilometre (3,280 feet) in length. If meeting these demands means that, compared with equivalent Western aircraft, the design comes out larger, or heavier, or with a shorter range or smaller bombload, these penalties are accepted. This is not the same as going for quantity instead of quality, but merely a slightly different order of priorities.

Western influence

Occasionally there can be little doubt that a Western design has been the inspiration for a Russian one, even though in detail engineering the latter is always totally original. Two examples which seem fairly clear are the Lockheed C-141 for the Il-76 and the General Dynamics F-111 for the basic new-build swing-wing configuration. Another is certainly the B-1 because, unless one of the B-1 prototypes is missing, the Tupolev OKB has built an almost exact replica and has the first prototype on the ramp at Ramenskoye (see page 12). According to various US publications the Russians have also built copies of the F-18 (ascribed to the MiG team) and the A-10 (said to be Su). When the truth comes out these reports are likely to appear inaccurate, though there is no doubt that for some years the Ramenskoye test centre has indeed been testing at least one new type of air-combat fighter and a straight-wing close-support aircraft. More likely there are two of each, in competitive evaluation. We know nothing like enough about them to include them in the same style as the rest of the entries in this book, and there is little point in repeating drawings purely invented by Western aviation publications.

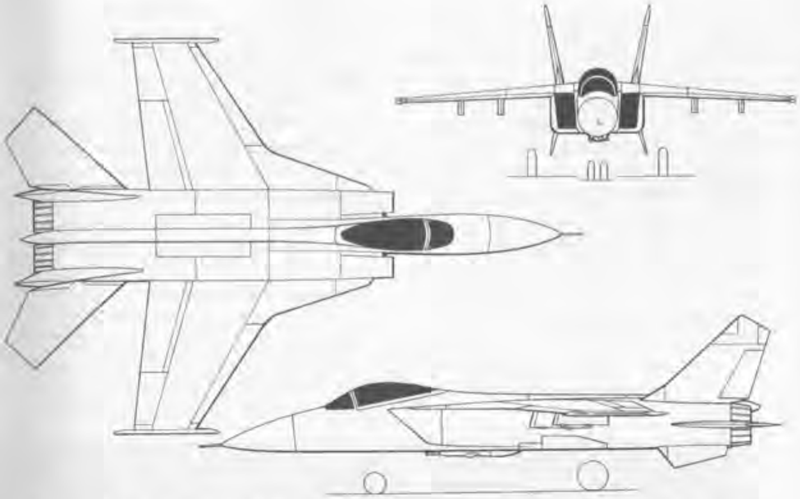
What is surprising is how few new military designs have appeared in the Soviet Union since 1967. Designing aircraft is one of the most difficult human occupations, and it may not be completely misleading to glance at current Soviet civil transport aircraft. The time it took to develop the Il-62, Il-86, Tu-144, Tu-154 and Yak-42 has been anything from four to seven times as long as typical US timing, measured from first flight to sustained passenger service. We do not yet understand the reasons for these protracted development periods, which are certainly not due to lack of knowledge, dedication or facilities. Can we afford to assume that the same protracted development is afflicting the programme for military aircraft?

A more likely explanation is that, while the factories pour out formidable numbers of today's extremely capable warplanes, the next generation has suffered from the colossal inroads into the Soviet defence budget made by ICBMs, LRBMs, mobile strategic and tactical missiles, SLBMs, gigantic submarines and surface warships—to say nothing of armour! Russians are methodical, they plan well ahead, and they will never allow any significant equipment gap to develop.

The Soviet Union has not held a public aviation display including new types of military aircraft since the show at Domodyedovo in July 1967. One can do little more than guess at the achievements since that date of the extremely large and hardworking project, design and development staffs of the military services, the national research organizations such as TsAGI and TsIAM, and the OKBs. A handful of prototypes have been observed by US reconnaissance satellites, notably on the experimental flight test centre at Ramenskoye, south-east of Moscow. The following are the types seen as prototypes and published in the West.

New fighter

Universally (but possibly erroneously) ascribed to the OKB named after Mikoyan and Gurevich, this aircraft is known by the US designation Ram-L (Ramenskoye type L). The prototype appears to have been first observed in early 1979. Artist's impressions and three-view drawings prepared in the United States show a configuration similar to the YF-17 or F-18. It is said to be twin-engined and to have an internal gun and up to eight AAMs, though this—like the numerical data such as 25,000-lb (11.34t) gross weight and combat radius of 575 miles (925km)—is pure speculation. Some publications even give this aircraft the designation MiG-29, which would be the expected designation if the OKB has been guessed correctly.



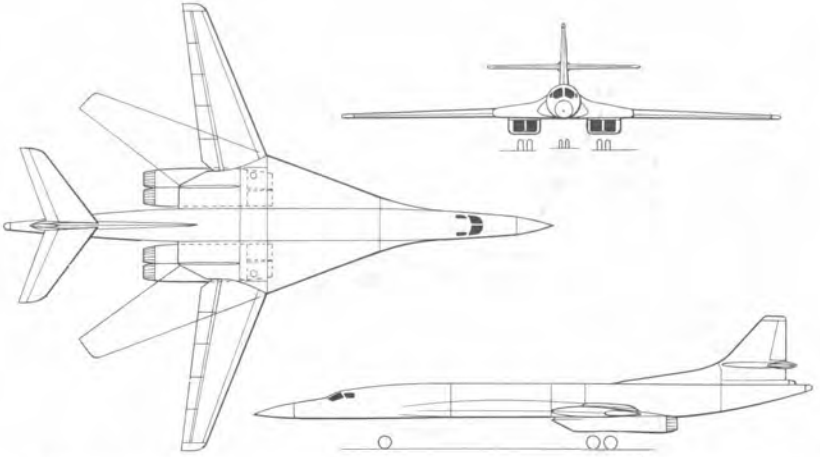
Above: Called 'Ram-L' by the Pentagon, and now surmised to be the MiG-29, this drawing (prepared for this book) is believed to be the most accurate yet published in the West. It is still guesswork.

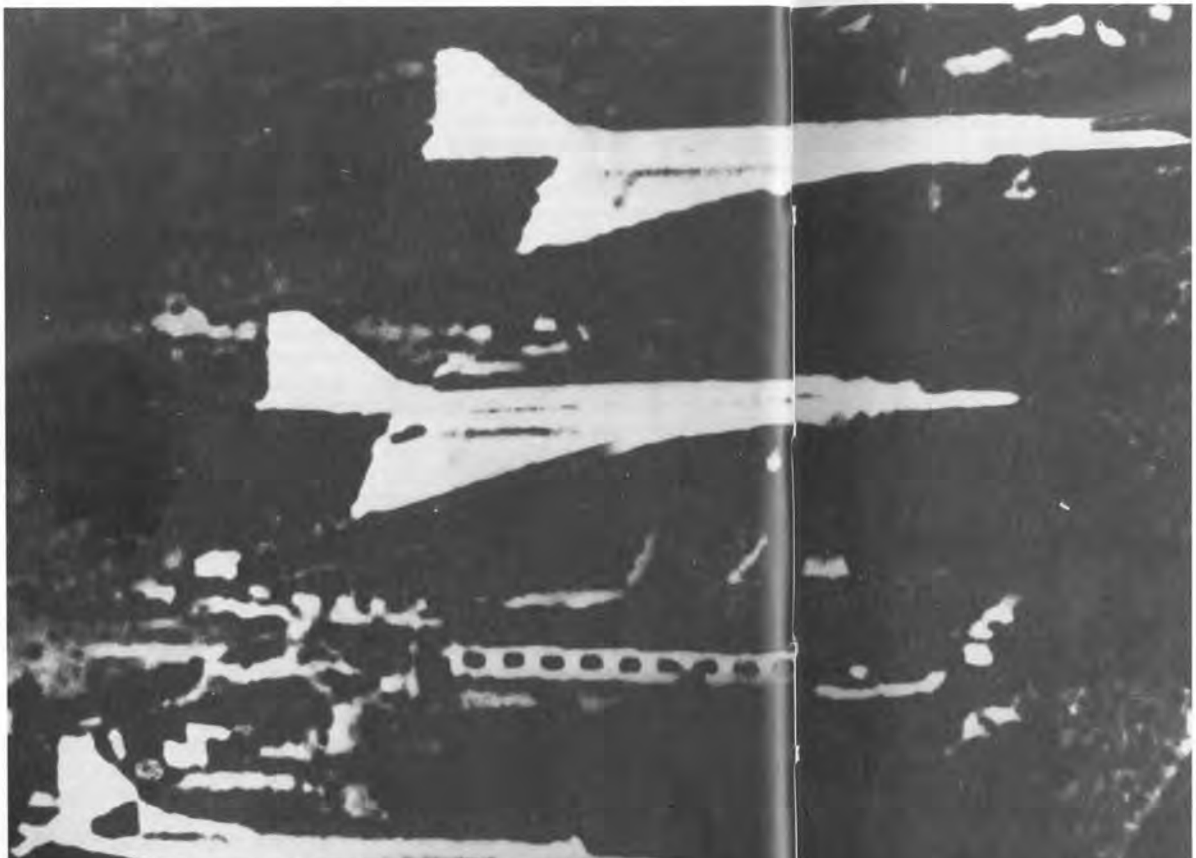
New close-support aircraft

Universally (and even more possibly erroneously) ascribed to the OKB named for Sukhoi, this is regarded as a counterpart of the USAF A-10 Thunderbolt II, and Western drawings show a very similar configuration. The first sighting of a prototype was in 1978, and a large number are probably now flying, the Pentagon designation being Ram-J. More recent reports state that the 'copy of the A-10' conclusion is misleading, and that this aircraft is more like an A-9A (unsuccessful Northrop rival to the A-10A). It is said to be smaller than either of the US aircraft, but to be powered by two R-13-300 turbojets (non-augmented) of 11,240lb (5.1t) each, giving considerably more takeoff thrust and an even greater margin of cruise thrust than either of the American machines. How US commentators can arrive at such a precise estimate of takeoff weight as '36,050lb (16.35t)' has not been explained. Ram-J is said to have a multi-barrel gun and ten weapon pylons. By 1982 the alleged VVS designation of Su-25 was becoming accepted in US circles; how such an aircraft could have a fighter (odd-number) designation is another factor yet to be explained.

New strategic aircraft

Following a spate of reports from the United States concerning a variable-sweep bomber to succeed 'Backfire', and further reports on canard (tail-first) bombers, all said to be of Tupolev design and to be known loosely by such names as "Bomber-H" and 'Bomber-K', a sudden injection of fact was made by the publication in the West (initially in *Aviation Week* for 14 December 1981) of a US satellite photo-





Left and below: Three-view drawing of the swing-wing long-range bomber called 'Ram-P' by the US Department of Defense, prepared solely from the electronically transmitted satellite picture below. With this form of transmission, plus atmospheric distortion, the shape of any one print-out contains errors; it needs many to get an accurate shape by averaging. Unlike the author, the very experienced artist has guessed four engines with nozzles in line. (*Photo: Aviation Week & Space Technology 1981*.)

▶graph showing a new strategic prototype parked at Ramenskoye near two Tu-144s or Tu-144Ds. At first glance the new aircraft—which is tentatively called the Ram-P—looks extremely similar to a B-1. The size and general configuration appear identical, but on closer inspection there are certain differences, and if the Ram-P is indeed of Tupolev origin it would be reasonable for as many parts as possible of the Tu-22M to be retained, including much of the basic fuselage, vertical tail, landing gears and parts of the outer wings.

New VG bomber

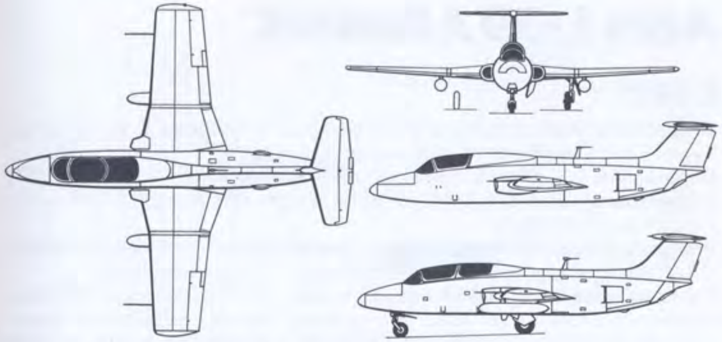
The Tu-22M has from the start been compromised by being a modification, aerodynamically related to the Su VG modifications of the old Su-7. Just as the Su OKB broke away to produce the Su-24, so has the new bomber been planned as an uncompromised design, with a short-span inner-wing glove and very long and slender pivoted outer wings. The main new feature is the location of the engines, under the wing roots as in the B-1. Instead of having minimum-length inlet ducts with inlets far back under the wing, as in the US bomber, the new Soviet machine appears to have variable inlets far forward with the ducts actually forming the sharp-edged gloves, which increase in depth to merge into the outboard engines. There may be two inboard engines, with nozzles further aft than the others, but another possibility is a third engine under the fuselage. The long-span horizontal tail is mounted well up the fin and appears to have anhedral; an earlier prototype with a very similar tail is said to have been first observed at Ramenskoye in 1979. Ram-P is said to have a dash speed of Mach 2.3 and unrefuelled range of 7,300 nautical miles (8,410 miles, 13,535 km). The consensus of opinion is that the aircraft is one of those previously identified in 1979 and that its appearance in combat regiments is likely in 1982.

Aero L-29 Delfin

L-29, 29A

Origin: Aero Vodochody national corporation, Vodochody, Czechoslovakia.
Type: Basic and advanced pilot trainer.
Engine: One 1,962lb (890kg) thrust Motorlet M 701c-500 turbojet.
Dimensions: Span 33ft 9in (10.29m); length 35ft 5½in (10.81m); wing area 213sq ft ($19.8m^2$).
Weights: Empty 5,026lb (2,280kg); loaded 7,231lb (3,280kg); maximum 7,804lb (3,540kg).
Performance: Maximum speed, 407mph (655km/h) at 16,400ft (5km), 382mph (615km/h) at sea level; economical cruise, 286mph (460km/h); initial climb 2,756ft (840m)/min; service ceiling 36,100ft (11km); range (internal fuel, medium heights), 398 miles (640km); maximum range (with drop tanks), 555.5 miles (894km).
Armament: Provision for various external loads including two 7.62mm machine-gun pods, two bombs of up to 220.5lb (100kg) or eight rockets.
History: First flight 5 April 1959, (first production aircraft) April 1963; completion of production 1974.

Development: Under agreements within Comecon and the Warsaw Pact, some items not involving advanced technology were assigned by the Soviet Union to satellite states, one of these being General Aviation (all aviation other than military and airline). This category includes agricultural aircraft, made mainly in Poland but also in Czechsolovakia and Romania, and also trainers, including military jet trainers. In 1960 a competition was held to select the first purpose-designed jet trainer for WP air forces (as distinct from dual-control versions of fighters), and it was won by the L-29, designed by a team led by K. Tomas and Z. Rublic and first flown with an imported Viper engine the previous year. The production machine is powered by the Czech M 701, unusual in adhering to the centrifugal type of compressor and, like the L-29 itself, designed not for flashing performance but for troublefree operation. Features include manual controls (with tabbed elevators on a



Above: Three-view of L-29, plus side view of L-29A Akrobat for aerobatic purposes (not used by Soviet Union).

trimming tailplane pivoted at the top of the fin), hydraulically operated Fowler flaps, rear-fuselage airbrakes and landing gear, fuel in two aluminium tanks in the fuselage (plus a small tank giving 15 seconds' inverted flight) and tandem ejection seats under canopies opening to the right over the front cockpit and sliding to the rear over the instructor. Poland did not accept the L-29, using its own TS 11, but the L-29 became standard in all other WP air forces and was widely exported. By 1974 some 3,600 had been delivered, of which about 3,000 were supplied to the Soviet armed forces. These included a very small number of the L-29A Delfin Akrobat single-seat acrobatic model; the USSR did not purchase the L-29R attack/recon variant.

Below left: A standard L-29 Delfin of the VVS photographed at the Vodochody plant before delivery to the Soviet Union. The two foot-steps on the left side are permanently fixed in place.

Below: There are few flying photographs of the L-29 in Soviet VVS service; this one is with the CL, the air force of its home country.

Aero L-39 Albatros

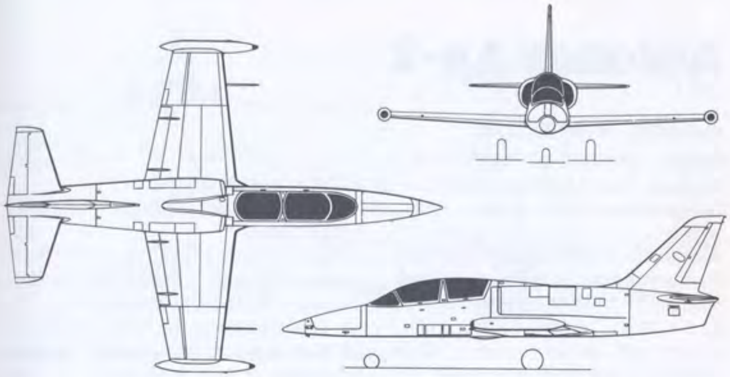
L-39C

Origin: Aero Vodochody national corporation, Vodochody, Czechoslovakia.
Type: Basic and advanced pilot trainer.
Engine: One 1,720kg (3,792lb) thrust Ivchyenko AI-25TL turbofan.
Dimensions: Span 31ft 0½in (9.46m); length 39ft 9½in (12.13m); wing area 202sq ft (18.8m²).
Weights: Empty 7,859lb (3,565kg); loaded (clean), 10,028lb (4,549kg); maximum (gun pod and two 100kg bombs), 11,312lb (5,131kg).
Performance: Maximum speed (clean, 19,685ft/6km), 485mph (780km/h), (four rocket pods, same height), 391mph (630km/h), (clean, light weight, sea level), 435mph (700km/h); initial climb (clean), 4,330ft (1,320m)/min; service ceiling (clean), 37,730ft (11.5km), (four rocket pods), 29,530ft (9km); range (clean), 683 miles (1,100km).
Armament: Normally none in Soviet service, but L 39Z carries centreline pod for GSh-23 gun with 150 rounds and wide range of underwing stores to maximum of 2,425lb (1,100kg) on four pylons (additional to fixed tip-tanks).
History: First flight 4 November 1968, (production L 39C) late 1972; service delivery, about December 1973.

Development: Designed by a team led by Dipl Ing Jan Vlcek, the L-39 was explicitly intended as a successor to the L-20 Delfin, and was planned from the start in collaboration with Russian officials and technicians to ensure suitability for VVS service. Whereas in the 1960 trainer selection there had been rival candidates, including one from Yakovlev in the Soviet Union, the L-39 merely had to meet all the requirements in order to go into production. A suitable engine already existed in the Ivchyenko AI-25 turbofan, giving higher trust than the L-29 engine and with lower fuel consumption. It was planned that this engine would be transferred to Czechoslovakia and made by Motorlet as the Walter Titan, but in the event initial supplies were provided by the Soviet Union and the AI-25 was later transferred to the Polish industry, though so far as is known all L-39 engines by 1982 had continued to be Russian-assembled.

Compared with the L-29 the newer Albatros shows a similar basic philosophy, with emphasis entirely on trouble-free operation over a long life. The engine is fed by wide lateral ducts extending forward well above the wing instead of through the wing to inlets at the leading edge. The variable-incidence tailplane is mounted on the fuselage, and the instructor is seated much higher than the pupil, as in all modern tandem trainers, giving him a better forward view. Fuel is housed in rubberized-fabric cells in the fuselage and two small fixed tanks on the wingtips, the combined capacity being greater than in the L-29. Provisions for simple field maintenance are more advanced than in the L-29, and the landing gear is suitable for rough unpaved airstrips. The flaps are of the double-slotted type, and the twin airbrakes are on the underside of the fuselage behind the wing leading edge (they are opened automatically should flight Mach number near 0.8). The crew sit in zero-height rocket-assisted seats under tandem canopies both hinged open to the right. Large left and right doors in the laminated glass-fibre nose provide access to the battery, oxygen, air bottles, aerials and various avionic items.

There are two armed models of L-39, designated L-39Z and L-39ZO, with four underwing hardpoints and reinforced wings and main landing gears. These are not used by the Soviet Union, though the standard L-39C trainer (Czech designation) does have provision for the GSh-23 gun. By 1982 the Soviet Union used approximately 1,000 L-39s, others being received by the Czech, East German and non-Warsaw Pact air forces. Production for the VVS is expected to continue for at least another four years.



Above: Three-view of standard L-39C trainer (tip tanks are fixed).

Left: A Czech Air Force L-39C which was one of the pre-production batch built in 1970-71, differing in small details (such as the engine inlet ducts) from the 1968 prototype. The armed L-39Z and L-39ZO are usually camouflaged but do not appear to be used by the USSR.

Antonov An-2

An-2P, V and ZA

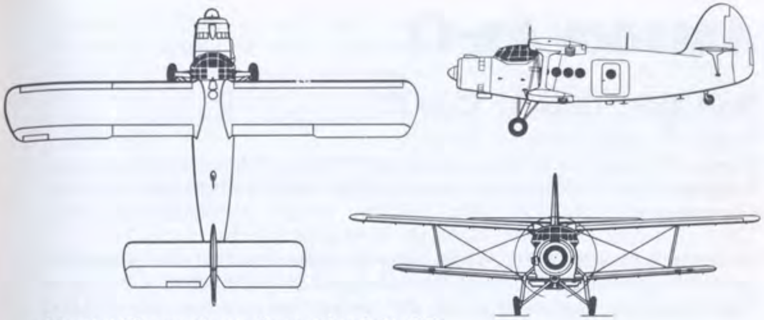
Origin: The OKB of Oleg K. Antonov.
Engine: One 1,000hp Shvetsov ASh-62IR nine-cylinder radial.
Dimensions: Span (upper wing), 59ft 8½in (19.18m); length (standard) 41ft 9½in (12.74m); wing area 770sq ft (71.5m^2).
Weights: empty (typical) 7,605lb (3,450kg); loaded 12,125lb (5,500kg).
Performance: Maximum speed (typical) 160mph (258km/h) at low altitudes; cruising speed, about 115mph (185km/h); initial climb (at 11,574lb/5,250kg), 689ft (210m)/min; service ceiling 14,425ft (4.4km); takeoff run (paved runway), 492ft (150m); minimum flying speed 56mph (90km/h); landing run 558ft (170m); range at low level with 1,102lb (500kg) payload, 562 miles (905km).
Armament: Usually none.
History: First flight 31 August 1947; service delivery 1948.

Development: Widely regarded as an obsolete anachronism when it appeared, the An-2 biplane has been made in quantities considerably greater than any other aircraft of the post-1945 era. Just over 5,000 were delivered in the Soviet Union in 1948-62 and for a brief period around 1965, about 9,500 at Mielec in Poland and an unknown number thought to be between 2,000 and 5,000 in China. The Soviet Union has been by far the largest customer, with almost all the Soviet-built total and about 7,500 of the Polish-built machines. Of this total of some 12,500 probably about 4,000 have gone to the armed forces (all branches) and para-military Dosaaf.

The original purpose of the An-2 was agricultural aviation but the basic qualities of the aircraft so appealed to the Soviet officials that it was subsequently made for many other purposes. The standard An-2P is a utility transport while the V is a twin-float seaplane and the ZA a substantially modified variant for high-altitude atmospheric sampling and research. All can be fitted with skis in winter.

Structurally the An-2 is made entirely of aluminium alloy, though the wings (aft of the front spars), tailplane and control surfaces are fabric-covered. One of the chief reasons for choosing the biplane configuration was to obtain good STOL (short takeoff and landing) and exceptional slow-flying qualities, and these were further improved by fitting four electrically driven slotted flaps, drooping ailerons and leading-edge slats. It is a substantial machine, much larger than typical lightplanes and with a cabin roughly the same cross-section as a DC-3 (though shorter), able to seat 12 passengers in 2+1 rows each aligned with a circular window on each side. In the cargo role a payload of 2,645lb (1,250kg) can be carried, and as an ambulance provision is made for six stretcher (litter) patients, in a triple tier on each side, and a seated attendant. As a paratroop transport there are six tip-up seats along each side of the cabin, and special equipment. In all models the flight deck seats two side-by-side, with access from the front of the cabin. The flight-deck side windows are built out like large bay windows on each side to give a perfect view downwards with the wings level. There are four basic types of propeller, one having four curved blades resembling scimitars.

At a rough guess the VVS and all other branches of the armed forces have maintained a force of some 3,000 An-2s throughout the past 30 years. Most have been used as utility transports for local use (for example more than 300 have been used in the Yakutsk region), carrying everything from food and ammunition to troops and their pay. Large numbers have served as standard trainers of radio operators and navigators, paratroops and even in electronic warfare (with special EW and ECM equipment fitted in or carried on the aircraft). So far as is known the An-2 has not been used for pilot training, though the An-2V has been used for instruction in flying marine aircraft.



Above: Three-view of standard An-2P.

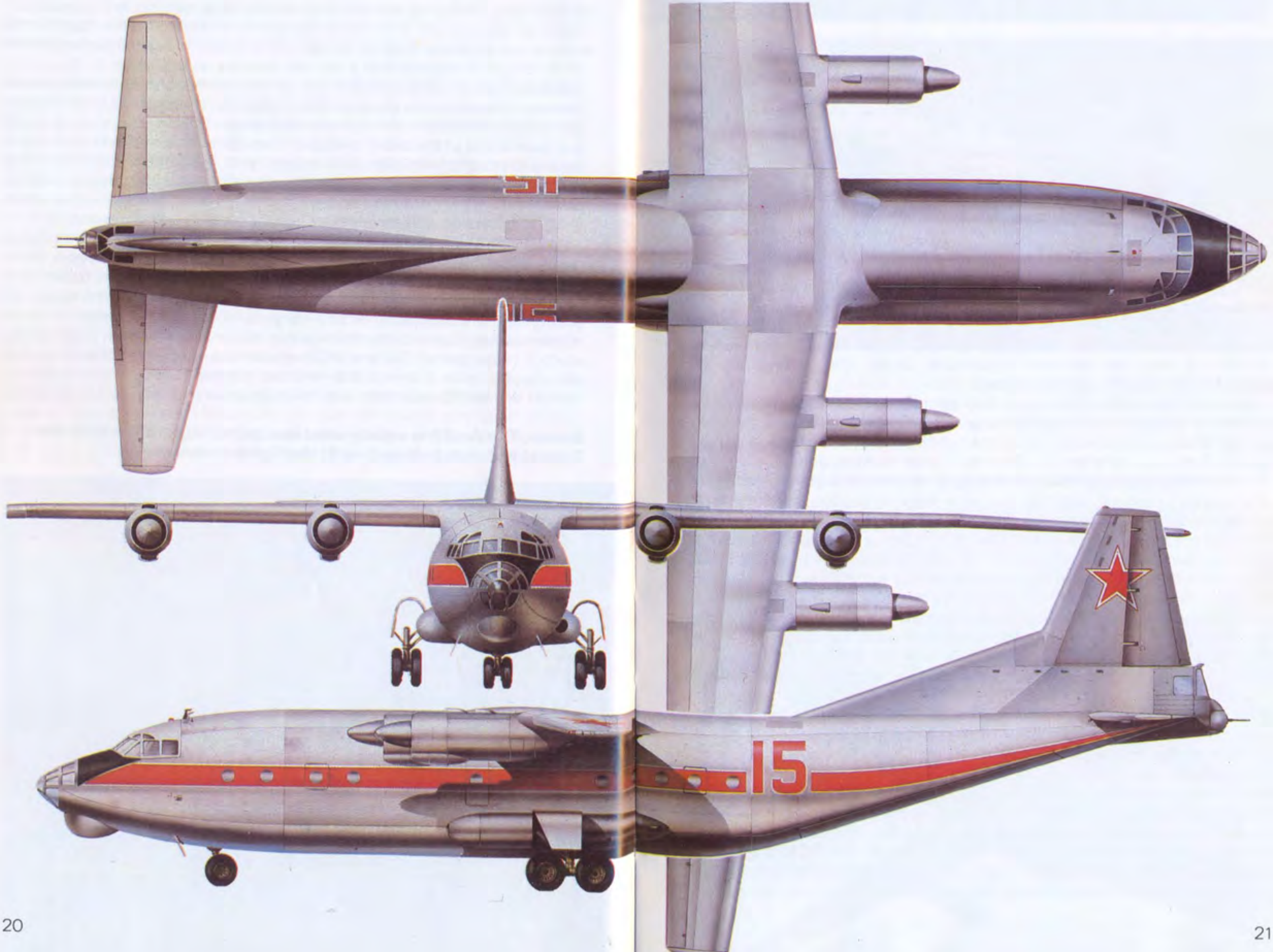
Below: The An-2P is widely used as a paratroop trainer with the Dosaaf and, it is believed, with the fighting services.

Antonov An-12

An-12BP, 'Cub-B', 'Cub-C'

Origin: The OKB of Oleg K. Antonov.
Type: (BP) heavy airlift transport, ('Cub-B') Elint, ('Cub-C') ECM.
Engines: Four 4,190ehp Ivchyenko AI-20M single-shaft turboprops.
Dimensions: Span 124ft 8in (38.0m); length (normal), 108ft 7¼in (33.1m); height 34ft 6½in (10.53m); wing area 1,310sq ft (121.7m²).
Weights: Empty (basic) 61,730lb (28t); maximum payload 44,090lb (20t); loaded 121,475lb (55.1t); maximum loaded 134,480lb (61t).
Performance: Maximum speed (BP, normal weight, medium altitude), 482mph (777km/h); maximum cruising speed 416mph (670km/h); economical cruise, 365mph (587km/h); minimum flying speed 101mph (163km/h); takeoff run (normal weight, paved runway), 2,295ft (700m); initial climb, 1,970ft (600m)/min; service ceiling 33,460ft (10.2km); range (maximum payload), 2,236 miles (3,600km), (maximum fuel) 3,542 miles (5,700km).
Armament: (BP) tail turret with two NR-23 guns, (other variants) none.
History: First flight, believed 1958; service delivery 1959; termination of production 1973. ▶

Below: An An-12BP seen on manoeuvres in 1978, one of perhaps an entire VTA regiment whose aircraft had scarlet fuselage stripes. Electronics are being enhanced; the guns are sometimes removed.



Left: This Polish An-12 is hard to distinguish from the civil An-10. The latter was withdrawn in 1972 after crashes, but the military An-12 is still used.
Below: Aeroflot (ostensibly civil) An-12 with turret over Indian Ocean February 1980.

▶**Development:** This aircraft, exactly comparable to the C-130 Hercules, was derived from the civil An-10 Ukraina of 1957 by redesigning the rear fuselage to incorporate a full-width rear ramp and loading doors and a tail turret. Curiously, the standard rear door comprises left and right halves which fold up internally, and a rear door hinged upward at the rear. Thus, provision is made for loading from trucks or for paradropping loads in flight, but not for easy loading of any kind of vehicle for which purpose a separate detachable ramp must be carried and fastened in place after the aircraft is parked. The large circular-section fuselage is pressurized and air-conditioned, and the engines drive large alternators feeding heater pads on the leading edges, on the engine inlets, propellers and windscreens to provide ice protection. Fuel is carried in 22 rubberized fabric cells in the wing, the normal capacity of 3,058gal (13,900lit) being increased for long-range missions to 3,981gal (18,100lit). The double-slotted flaps, retraction of the bogie landing gears and steering of the nosewheels are all effected hydraulically, though flight controls are manual. Like many Soviet aircraft the An-12 wing has anhedral (downward slope). The landing gear is designed for use on unpaved surfaces.

Normal flight crew comprises two pilots side-by-side, with full dual control, a navigator in the glazed nose, a radio/radar operator on the left behind the pilot and an engineer on the right behind the co-pilot, and the tail gunner who also manages the Gamma-A radar warning and direction set. The main mapping and airdrop radar has the Western code-name Toad Stool and operates in I-band, with the scanner in the chin position under the floor of the navigator's compartment. The main cargo hold is 44ft 3½in (13.5m) long and has a maximum width of 11ft 5¾in (3.5m), and the floor is stressed to accept loads of up to 307lb/sq ft (1.5t/m^2). Cargo can be positioned with the aid of a hoist running on a fore-and-aft gantry with a capacity of 5,071lb (2.3t). In the paratroop role 100 soldiers can be seated on small folding seats along the walls and down the centre and despatched in less than one minute through the rear aperture with doors folded upward. Vehicles can include the PT-76 amphibious tank and derivatives, BTR-60, BMP, ASU-85 SP gun, ZSU-23/4 AA vehicle and various SAM launcher vehicles.

It is estimated that about 850 of the basic An-12BP were built, of which some 720 were supplied to the VTA. Though supplemented by the Il-76, at least 500 remain in service, many having a new main radar with a larger aerial. A small number have been converted into Elint (electronic intelligence) platforms to detect, monitor, record and analyse electronic signals from NATO ships, aircraft and surface forces. Called 'Cub-B' by NATO (its actual designation is not known in the West), it retains the tail turret but has a main cabin filled with electronics and operator consoles. At least 14 additional aerials have been identified, mostly on the fuselage. The ECM (electronic countermeasures) model, called 'Cub-C', is a more extensive rebuild with the turret replaced by a large dielectric rear radome. It has several high-power

jammers including canoe type aerial fairings on the underside of the fuselage ahead of and behind the main-gear fairings, and bulged rear ramp/doors. About 30 of this version are serving with the VVS and AVMF in a strategic capacity.

Below: One of a formation engaged in paratroop exercises.

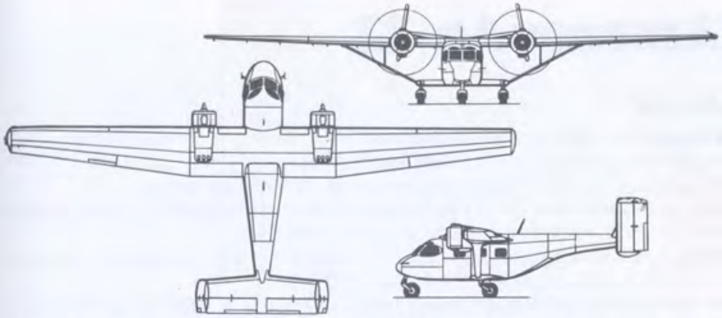
Antonov An-14 Pchelka

An-14A

Origin: The OKB of Oleg K. Antonov.
Type: Light STOL transport.
Engines: Two 300hp Ivchyenko AI-14RF nine-cylinder radials.
Dimensions: Span 72ft 2in (21.99m); length 37ft 6½in (11.44m); wing area 427.5sq ft ($39.72m^2$).
Weights: Empty about 4,409lb (2t); maximum payload 1,587lb (720kg); loaded 7,935lb (3.6t).
Performance: Maximum speed (3,280ft, 1km), 138mph (222km/h); cruising speed 112mph (180km/h), initial climb 1,000ft (305m)/min, service ceiling 17,060ft (5.2km); takeoff run (paved runway), 328ft (100m); landing run 230ft (70m); range with maximum payload, 404 miles (650km); range with maximum fuel, 497 miles (800km).
Armament: None.
History: First flight (original prototype) 15 March 1958, (production An-14A) 1965; service delivery 1967.

Development: The An-14 Pchelka (Little Bee) was designed to meet a civil demand for a light transport smaller than the An-2 but with at least as good a STOL performance for operation from any short level surface. The prototype suffered from minor problems, but Antonov's team at Kiev was preoccupied with the An-12 and An-24, and the GVF (civil air fleet) requirement kept changing, so that over a period of seven years a completely

Below: Many hundreds of An-14s are a familiar sight in the most remote parts of the Soviet Union. They can use every airfield.



Above: Three-view of An-14; some military examples have radar.

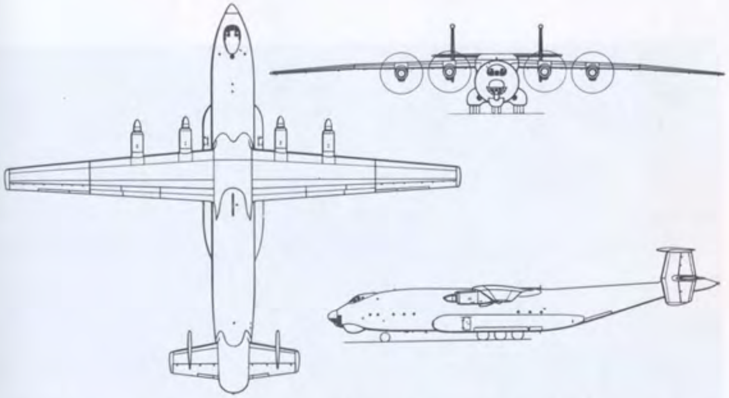
different An-14 emerged, with much longer glider-like wings and outstanding flying qualities, enabling it to be flown by even the most inexperienced pilot. One requirement was maintenance of height on one engine, and another was the ability to fly at night or in adverse weather. The engines drive three-blade (sometimes two-blade) variable-pitch and feathering propellers and draw fuel from four wing tanks. The wings have full-span slats and double-slotted flaps, all driven pneumatically, with ailerons inset in the outer flap sections. De-icing is by hot air and electric heater mats. The soft-field wheels can be replaced by skis or floats. The cockpit seats a pilot (on the left) and passenger, and the main cabin six or seven passengers or six stretcher casualties and an attendant. Many hundreds of these very popular machines were built, a small number (perhaps 100, but that is a mere guess) going to the VVS as utility transports, photographic aircraft and, in at least two cases, as ambulances.

Antonov An-22

An-22

Origin: The OKB of Oleg K. Antonov.
Type: Heavy cargo airlift transport.
Engines: Four 15,000shp Kuznetsov NK-12MA turboprops.
Dimensions: Span 211ft 4in (64.4m); length 190ft 0in (57.92m); height 41ft 1½in (12.53m); wing area 3,713sq ft (345m²).
Weights: Empty (equipped), 251,323lb (114t); maximum payload 176,367lb (80t); loaded 551,150lb (250t).
Performance: Maximum speed (medium altitudes), 460mph (740km/h); high-speed cruise, 422mph (679km/h); takeoff run, 4,260ft (1.3km); landing run (minimum), 2,625ft (800m); range with maximum fuel and 99,200lb (45t) payload, 6,804 miles (10,950km); range with maximum payload, 3,110 miles (5,000km).
Armament: None.
History: First flight 27 February 1965; service delivery, spring 1967; completion of production 1974.

Development: Bearing in mind a Soviet tradition of very large aircraft, and the fact that heavy airlifters were needed both for military purposes and to open up the vast untapped potential of many parts of the Soviet Union (even including some parts of Russia, but especially in the Asiatic territories), it is remarkable that this mighty machine was not built at least ten years earlier when the engine was first cleared for production. Unlike most Soviet transports the An-22 had to be designed with an exceptionally high wing loading (nearly 150lb/sq ft, 0.75t/m²), but that did not stop Antonov from achieving quite short field lengths and landing gear able to operate from unpaved strips. The main gear comprises three tandem pairs of levered- ▶



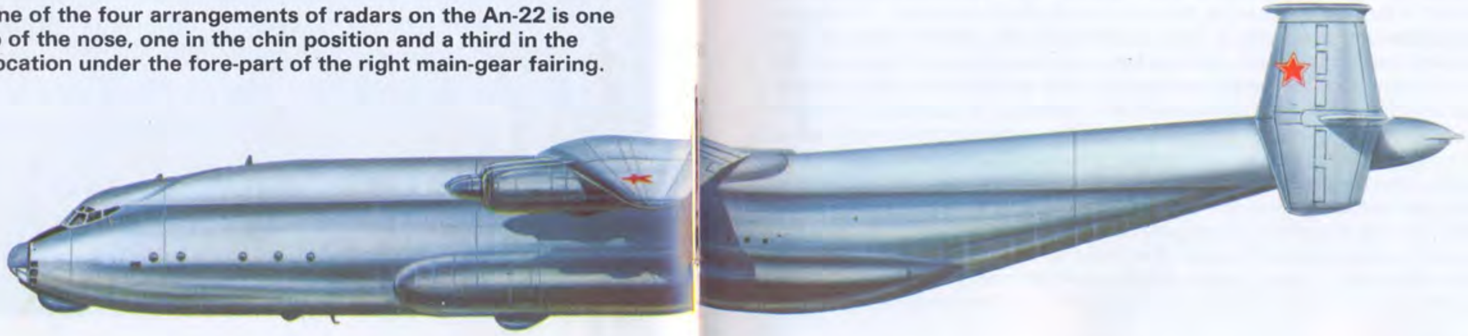
Above: Three-view of An-22 with triple nose radars and none elsewhere.

Below: This military An-22 of the VTA is unusual in having a plain glazed nose devoid of any radar (the only radome is under the large fairing for the right main landing gear). Note the anhedral.

▶suspension wheels on each side of the aircrasft, each attached to a fuselage ring frame picking up one of the three wing spars. Tyre pressures are adjustable in flight. The four large turboprop engines draw fuel from integral tanks filling the main wing inter-spar box, and drive contra-rotating pairs of four-blade reversing propellers of 20ft 4in (6.2m) diameter. The wings have large double-slotted flaps, and the unusual tail has twin fins with almost their entire area ahead of the leading edge of the remarkably small tailplane. For a change the vast cargo compartment is fully pressurized, yet has an integral ramp for loading vehicles. The An-22 can carry any item normally transported by Soviet assault forces, and is the only aircraft able to fly the T-62, T-72 and T-80 battle tanks.

Dimensions of the main hold are: length 108ft 3in (33.0in); maximum width and height, both 14ft 5in (4.4m). The floor is of titanium. Heavy cargo

Below: One of the four arrangements of radars on the An-22 is one in the top of the nose, one in the chin position and a third in the original location under the fore-part of the right main-gear fairing.



Above: The impressive size of the An-22 is emphasized by this helicopter view of a civil example parked next to a Tu-124 jetliner.

Left: So far as is known the military An-22 can airlift any item of portable equipment in the Soviet inventories. In the foreground are an APC and SP gun, the latter (SU-85) being carried in threes.

can be hoisted and positioned by two 5,511lb (2.5t) winches travelling on four gantries along the length of the roof of the hold, extending to the rear along the underside of the aft-hinged rearmost door (aft of the ramp) where the winches overhang the ground or a truck. Normal flight crew numbers five or six, who can enter via doors in the forward part of each main landing gear fairing, leading to a stairway to the main hold and a forward stairway to the flight-deck level where there is also seating for 28 or 29 passengers. In early An-22s the main radar was in the underside of the right main-gear fairing, but in the main production batch this region was occupied by a gas-turbine auxiliary power unit and pressurization equipment, with a ram air inlet in the front of both the left and right fairings. The main mapping radar was moved to a large blister radome under the nose, with a second weather radar added above in the tip of the nose. The two radars did not prevent the▶

▶provision of large glazed areas for the navigator. No fewer than 27 world records were set by An-22 Anteis (the name means Anteus, the giant son of Poseidon also called Neptune), including a string of records to heights up to 25,748ft (7,848m) with a cargo of metal blocks weighing 100 445kg (221,443lb). Only about 50 to 60 were built, of which perhaps half were supplied to the VTA. They have been used for many notable military airlifts to such countries as Libya, Morocco, Somalia, Vietnam and Peru, and have also been prominent in major manoeuvres with WP forces.

Left: Possibly half the An-22s built have operated with the civil air fleet (GVF), though their civil registration numbers are confusing. This aircraft, 67691, is one of an early series with no radar in the nose at all, though retaining the radome under the right main-gear fairing. It has blue-painted spinners and rudders, and white upper surfaces and fins. Both civil and military examples have participated in strategic overseas airlifts.

Antonov An-24

An-24V, T

Origin: The OKB of Oleg K. Antonov.
Type: Short-range transport.
Engines: Two 2,550ehp Ivchyenko AI-24 Series 2 single-shaft turboprops, or two 2,820ehp AI-24T.
Dimensions: Span 95ft 9½in (29.2m); length 77ft 2½in (23.53m); wing area 807.1sq ft (74.98m²).
Weights: Empty (typical, equipped), (V) 29,321lb (13.3t), (T) 30,996lb (14,060kg); maximum payload (V) 12,125lb (5.5t), (T) 10,168lb (4,612kg); loaded 46,296lb (21t).
Performance: Maximum speed 311mph (500km/h); typical cruising speed, 280mph (450km/h); initial climb 1,515ft (462m)/min; service ceiling 27,560ft (8.4km); takeoff run (sea level, ISA), 1,970ft (600m); range with maximum payload, (V) 341 miles (550km), (T) 397 miles (640km); range with maximum fuel, (V) 1,490 miles (2,400km), (T) 1,864 miles (3,000km).
Armament: None.
History: First flight April 1960; service entry (VVS) 1964; termination of production 1978.

Development: Designed as a replacement for the Li-2 and Il-12 and -14 piston-engined aircraft on Aeroflot routes, the An-24 also replaced the same aircraft in the military services, though in much smaller numbers. Planned as a 32-seater, it grew to have 11 rows of four by the time the first example flew, and production machines have various seating configurations up to 13 rows of four. The twin-wheel landing gears and single-slotted flaps (double-slotted outboard of the long nacelles) are operated hydraulically. Wing and tail, windscreens, engine inlets and propellers all have thermal de-icing, mainly by electrical power. The fuselage cross section is made up of three circular arcs giving a relatively broad low-slung floor (with no underfloor holds) and flattish underside. Pressurization and environmental control is by bleed air, with a heat exchanger and turbo-cooler in each nacelle. Some of the military An-24s are of the basic An-24V and V Series II models, with flight crew of five (two pilots, radio officer, navigator and engineer or cargo loadmaster) and various furnishing arrangements. The majority are of the

Above: This An-24 is the An-24RV prototype, engaged in testing a new eight-blade propeller which considerably reduces airfield noise.

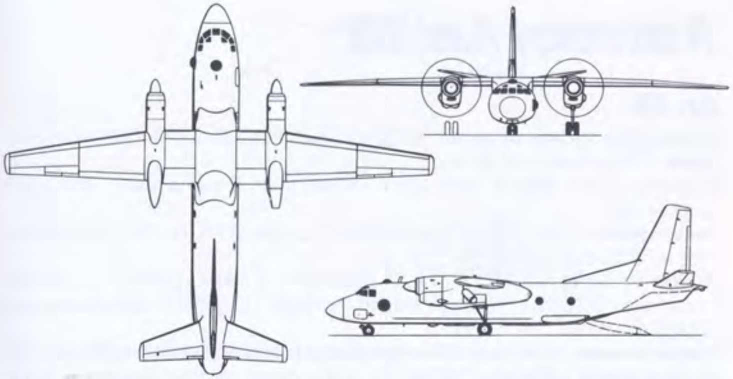
An-24T cargo version with a broader rear fuselage incorporating an upward-hinged full-width rear loading door, and with twin inclined ventral strakes instead of a central ventral fin. With the door hinged open freight can be loaded by a hoist of 3,307lb (1.5t) capacity running on rails along the ceiling. There is also a powered conveyor along the metal floor, with capacity of 9,921lb (4.5t). Most 24Ts have fewer windows, and in the paratroop role have 40 tip-up wall seats and provision for dropping via the rear door. It is possible that the VVS or other military branch purchased the casevac (ambulance) version, or one of those with engine-out performance improved by fitting a turbojet APU/boost engine in the rear of the right nacelle. About 1,100 of all variants of An-24 were built, of which perhaps 150 serve with the Soviet armed forces.

Antonov An-26

An-26, 26B

Origin: The OKB of Oleg K. Antonov.
Type: Short-range airlift transport.
Engines: Two 2,820ehp Ivchyenko AI-24T single-shaft turboprops plus one 1,765lb (800kg) thrust RU-19A-300 auxiliary turbojet in right nacelle.
Dimensions: Span 95ft 9½in (29.2m); length 78ft 1in (23.8m); wing area 807.1sq ft ($74.98m^2$).
Weights: Empty 33,113lb (15,020kg); payload (normal) 9,921lb (4.5t), (maximum) 12,125lb (5.5t); loaded (normal) 50,706lb (23t), (maximum) 52,911lb (24t).
Performance: Maximum speed 335mph (540km/h) at 19,685ft (6km); high-speed cruise at same height 273mph (440km/h); normal cruise at 22,965ft (7km), 264mph (425km/h); initial climb (normal weight, with jet), 1,575ft (480m)/min; service ceiling 24,600ft (7.5km); takeoff to 50ft (15m) (paved runway), 4,068ft (1.24km); landing from 50ft (15m), 5,709ft (1.74km); range (max payload, no reserves), 683 miles (1,100km), (max fuel, no reserves), 1,584 miles (2,550km).
Armament: None.
History: First flight not disclosed but probably 1968; service delivery, probably 1969.

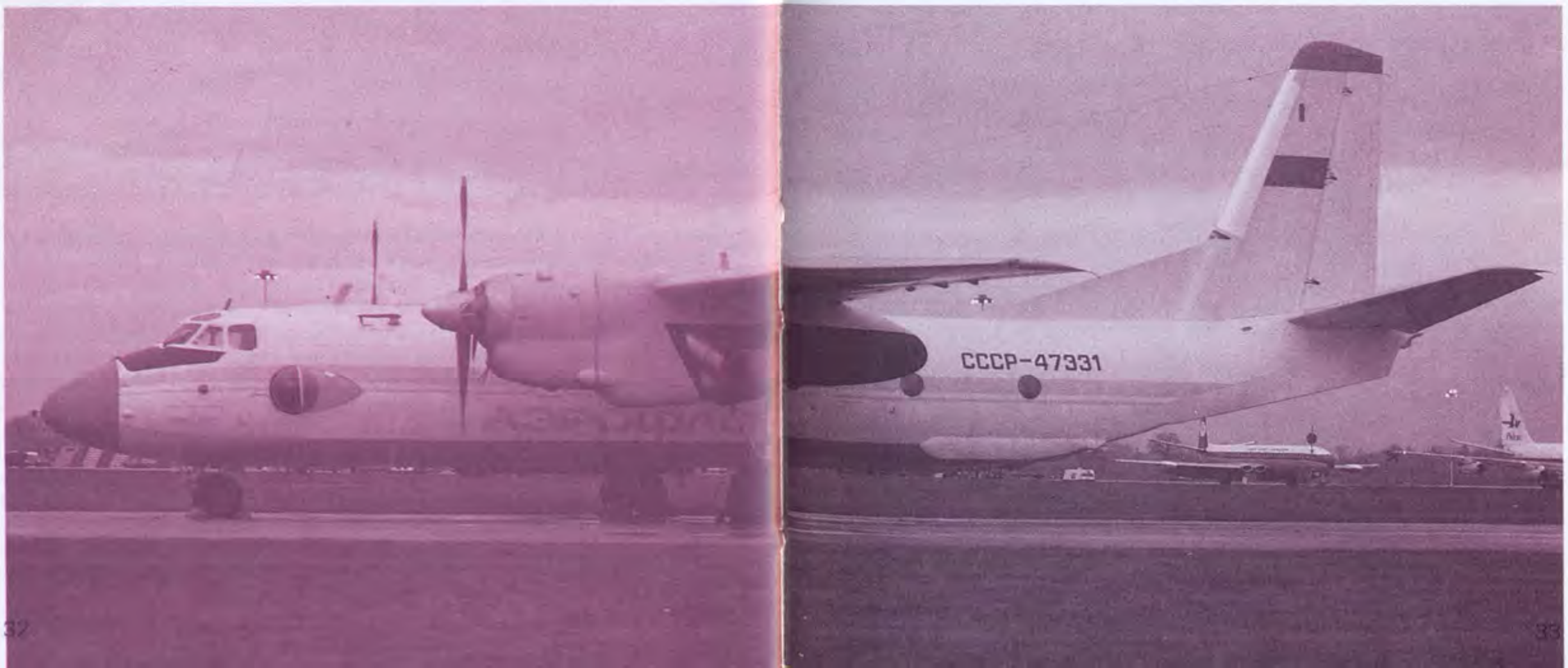
Development: First seen in public at the Paris airshow in early summer 1969, this derivative of the An-24 has a redesigned rear fuselage with a much more useful full-width rear ramp/door of Antonov's own invention. Though constructed like a normal loading ramp for vehicles, it can be disconnected from its normal hinges at the front and swung down on left/right sets of parallel arms to lie horizontally under the fuselage. This facilitates direct loading from trucks or conveyors, and can also be done in the air (the door being faired in by inclined strakes along each side of the fuselage) to allow air-dropping of stores. When closed the door forms the underside of the wide beaver-tail rear fuselage in the usual way, closing between large left/right underfins which improve airflow and directional



Above: Three-view of An-26; note engine nacelles in plan view.

stability and incorporate tail bumpers. The fuselage underskin is a sandwich of duralumin and (outermost) titanium to resist damage from operations from rough unpaved surfaces, and there is local reinforcement elsewhere to resist damage from flung stones. Airframe is that of the An-24 but restressed for higher weights, and the systems are generally similar though there are ten (instead of four) flexible cells for fuel in the centre section increasing mass to 12,125lb (5,500kg). Flight crew is five as before, but with the addition of radar (not often fitted to the An-24), a large airdrop observation blister on the left side, airdrop sight and loadmaster/dispatcher station at the rear on the right. Small vehicles can be driven on board, and in the casevac role 24 stretcher (litter) patients can be accommodated, with attendant. In the troop or paratroop role up to 40 tip-up wall seats are used. About 100 are believed to serve with the VTA and possibly as many again with other arms, a few being of the new An-26B type with improved equipment for stowing and securing three cargo pallets.

Below: A civil-registered An-26 in transit through Britain (Gatwick) to Cuba in 1979. It has the airdrop observation blister.



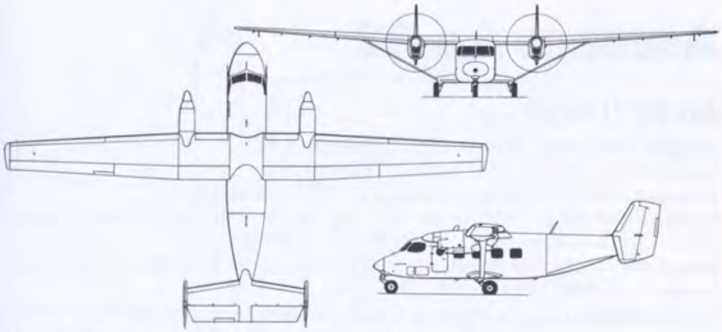
Antonov An-28

An-28

Origin: The OKB of Antonov; production at PZL Mielec, Poland.
Type: STOL multi-role transport.
Engines: Two 960hp PZL-10W (Polish-built Glushyenkov TVD-10B) turboprops.
Dimensions: Span 72ft 4½in (22.06m); length 42ft 7in (12.98m); wing area 433.6sq ft (40.28m²).
Weights: Empty 7,716lb (3.5t); payload (normal) (3,415lb (1,550kg), (maximum) 3,750lb (1,700kg); loaded (normal) 12,785lb (5.8t), (maximum) 13,450lb (6.1t).
Performance: Maximum cruising speed 217mph (350km/h); economical cruising speed 186mph (300km/h); initial climb (normal weight) 2,460ft (750m)/min; service ceiling, not stated; takeoff to 50ft (15m) (normal weight), 1,085ft (330m); landing from 50ft (15m), 942ft (287m); range at econ cruise and 30min reserve, (20 passengers), 317 miles (510km), (maximum fuel), 807 miles (1,300km).
Armament: None.
History: First flight September 1969; service delivery probably 1982.

Development: Like most recent Soviet civil aircraft, the An-28 has suffered extremely prolonged development, though the final result has been worth waiting for. Designed to meet a civil need for a light STOL transport larger than the An-14 and more modern than the An-2, it has an extremely long-span wing with double-slotted flaps and slotted drooping ailerons across the whole span, as well as automatic leading-edge slats. The metal stressed-skin airframe is designed to last for many years in extremely harsh environments,

Below: By 1982 large numbers of civil An-28s were in service with Aeroflot, and a few deliveries had been made to the VVS for use as liaison aircraft, ambulances and possibly in various other roles.



Above: Three-view of standard civil An-28.

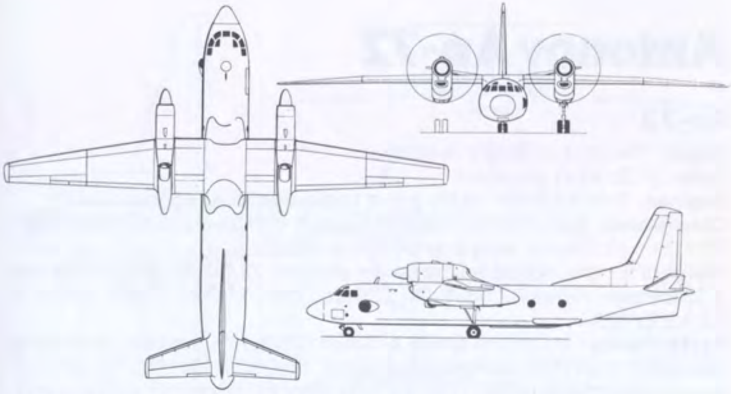
and all leading edges are de-iced by economical use of hot bleed air from the small turboprop engines which drive reverse-pitch propellers. The latter, and the engine inlets and pilot windshields, are anti-iced electrically. The main cabin is 17ft 3in (5.26m) long and almost of DC-3 cross-section, so that it can seat 15 passengers in five rows (2+1 seat units) or up to 20 in a high-density arrangement. At the rear is a typical Antonov full-section ramp door which can be pivoted down to load small vehicles or swung down on parallel arms under the fuselage for loading other cargo or for air-dropping. In the casevac role a normal arrangement provides for six stretchers (litters), five seated patients and an attendant with medical equipment. In the paratroop role six men plus dispatcher can be carried. Comprehensive avionics are carried for all-weather operation. First deliveries, due before the end of 1982, are likely to go to various Aeroflot directorates, but the Soviet armed forces are likely to use large numbers of these extremely versatile aircraft, as utility transports, VIP liaison aircraft, paratroop and casevac airlifters, crew trainers for navigation, radio, radar and electronic warfare, and possibly (though such a variant has not been identified) for offshore patrol. Skis and floats have been tested and can be fitted when necessary.

Antonov An-32

An-32 (Cline)

Origin: The design OKB of Oleg K. Antonov, Kiev.
Type: STOL transport for hot/high airstrips.
Engines: Two 5,180ehp Ivchyenko AI-20M turboprops.
Dimensions: Span 95ft 9½in (29.2m); length 78ft 1in (23.8m); height 28ft 1½in (8.575m); wing area 807.1sq ft (74.98m²).
Weights: Empty, not published in 1982 but about 35,000lb (15,876kg); loaded 57,320lb (26t).
Performance: Cruising speed 317mph (510km/h); service ceiling 31,150ft (9.5km); range with max payload (see text), 45min reserves, 497 miles (800km); range with max fuel, 45min reserves, 1,367 miles (2200km).
Armament: None.
History: First flight, shortly before May 1977.

With almost the same airframe as the An-24 and -26, the An-32 is fitted with turboprops of almost double the power, for exceptional STOL (short takeoff and landing) capability in operations from the most demanding hot and high-altitude airfields. The engines are AI-20s, of the same basic type as fitted to the Be-12, Il-38 and other aircraft; but they are of a modified type offering even greater power, absorbed by four-blade propellers of 15ft 5in (4.7m) diameter. These are mounted high on the wings to give a high thrust-line, the resulting nacelles being very deep to house the retracted main gears under the wing. The tailplane is slightly larger than in other Antonov twin-turboprops, and its leading edge carries a full-span fixed inverted slat.



Above: Three-view of An-32 STOL transport.

Another major change is a great increase in the size of the twin ventral underfins at the tail, on each side of the rear upward-hinged portion of the main ramp/door. Maximum payload is slightly greater than that of the An-26, at 6t (13,228lb), and the same 2t-capacity electric hoist is installed. Up to 39 passengers, 30 paratroops or 24 stretchers (litters) can be installed. In 1982 no VVS example had been seen, but the An-32 was being supplied to the Indian Air Force.

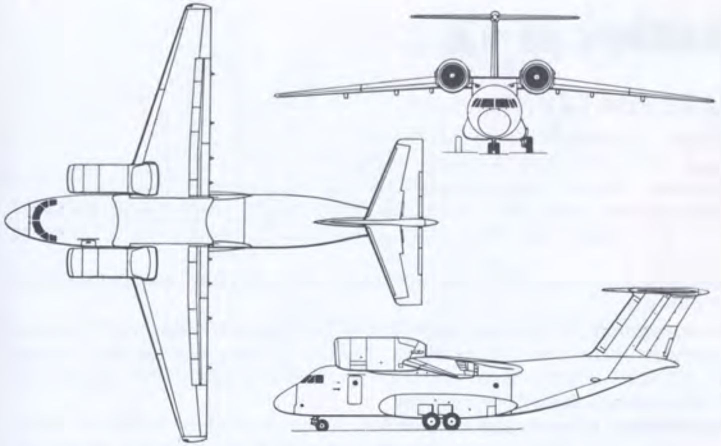
Below: With same basic wing and fuselage of the An-24, the An-32 has AI-20 turboprops for greater power.

Antonov An-72

An-72

Origin: The OKB of Oleg K. Antonov.
Type: STOL airlift transport.
Engines: Two 14,330lb (6.5t) thrust Lotarev D-36 turbofans.
Dimensions: Span 84ft 9in (25.83m); length 87ft 2¼in (26.576m); height 27ft 0¼in (8.235m); wing area 969sq ft (90m²).
Weights: Empty, not stated; maximum payload, 22,045lb (10t); loaded (for 3,281ft/1km runway), 58,420lb (26.5t), (for 4,925ft/1.5km runway), 72,750lb (33t).
Performance: Maximum speed 477mph (760km/h); maximum cruising speed, 447mph (720km/h); service ceiling, 36,090ft (11km); STOL takeoff, ground run 1,542ft (470m) and rotate at 94mph (150km/h); landing speed, 103mph (165km/h); range with 30-min reserve, (maximum payload), 621 miles (1,000km), (maximum fuel), 2,360 miles (3,800km).
Armament: None.
History: First flight 22 December 1977; service delivery, possibly 1982.

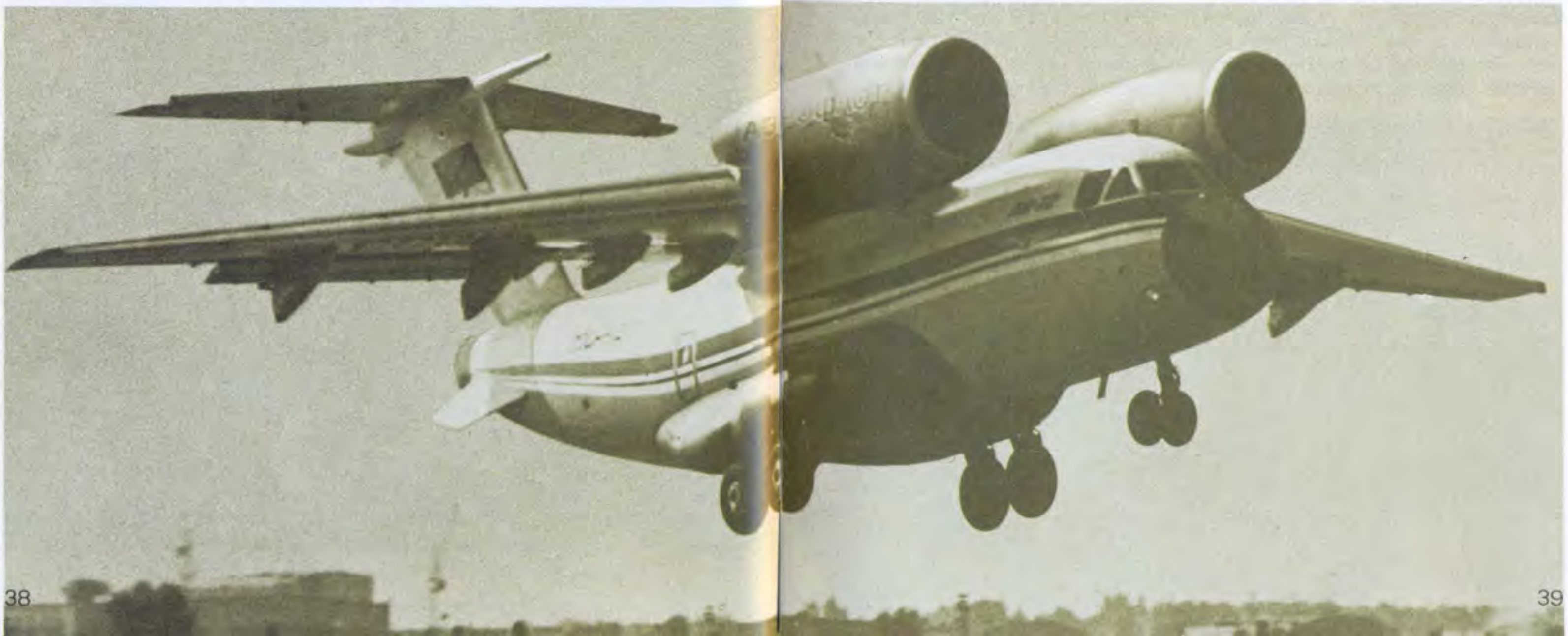
Development: This STOL (short takeoff and landing) airlifter was designed to use precisely the same USB (upper-surface blowing) technique as the much larger American Boeing YC-14, though some of the high-lift features may be omitted from production. A clean and modern aircraft, the An-72 is of an unusual size, considerably larger than the An-26 class twin-turboprops yet still small by military airlift standards and barely half the weight of a C-130. The wing is unswept but tapered on the leading edge only, and has sharp anhedral outboard of the large fan engines which blow across the inboard portions. The trailing edge has small ailerons outboard and large tracked flaps inboard, triple-slotted outboard of the engines and double-slotted inboard, preceded by five sections of spoiler on each side for roll augmentation, steep letdown and lift dump after landing. The leading edge



Above: Three-view of the second An-72 (modified rear fuselage).

comprises a full-span powered droop, with thermal de-icing. The T-tail includes a powered tailplane with separate elevators to increase camber and a double-hinged powered rudder. The main gears, which fold into fairings outside the pressurized fuselage, comprise tandem dual pairs of wheels with low-pressure tyres for rough strips (the two prototypes had tandem single wheels). The main cabin is 29ft 6¼in (9.0m) long, 6ft 10¾in (2.1m) wide at floor level and 7ft 2½in (2.2m) high. The Antonov-style rear ramp/door, in production aircraft to swing down under the fuselage for truck-bed loading or air-dropping, can admit modest vehicles and pallets of 75 x 95 inch (1.90 x 2.42m) size, other loads including 32 troops or paratroops on tip-up wall seats or 24 stretcher (litter) casualties plus a medical attendant. The modern flight deck can be managed by two pilots, but an engineer's jump seat is provided between them to the rear (the seat is on tracks to move aft to the right side between flights). Nothing has been said about deployment of either civil or military An-72 aircraft, but development has been swift and successful and production aircraft may be expected to appear before 1983.

Below: The first An-72 making a slow fly-past with very little flap, and with the control column held well back. The production model will have four-wheel bogies and simplified high-lift systems.



Beriev M-12

M-12 (Be-12)

Origin: The OKB of Georgii M. Beriev.
Type: Multi-role reconnaissance amphibian.
Engines: Two 4,190ehp Ivchyenko AI-20D single-shaft turboprops.
Dimensions: Span 97ft 5¾in (29.71m); length (with MAD) 99ft 0in (30.17m); height (on land) 22ft 11½in (7.0m); wing area 1,130sq ft (105m²).
Weights: Empty, not disclosed but about 44,000lb (20t); loaded 64,925lb (29,450kg).
Performance: Maximum speed 378mph (608km/h); normal patrol speed 199mph (320km/h); initial climb 2,990ft (912m)/min; service ceiling 37,000ft (11.28km); range with maximum fuel and operational equipment, 2,485 miles (4,000km).
Armament: Internal bay in hull for unknown load of ASW or other weapons; four underwing hardpoints outboard of engines each capable of taking ASW torpedoes or similar stores; in some aircraft, rocket rails are added further outboard.
History: First flight, probably 1960 (several prototypes by summer 1961); service delivery, believed 1965.

Development: Having approximately the same configuration, size and weight as the Be-6, which it replaced in front-line AVMF regiments, the M-12 actually has a hull more closely derived from the twin-jet Be-10 designed at the same time (1958-60), which had much higher performance and set several world class records but suffered from too short a range to be useful. In contrast the M-12 (OKB number, Be-12) has no shortcoming, and eventually settled down to give very good service as an extremely versatile and useful machine.

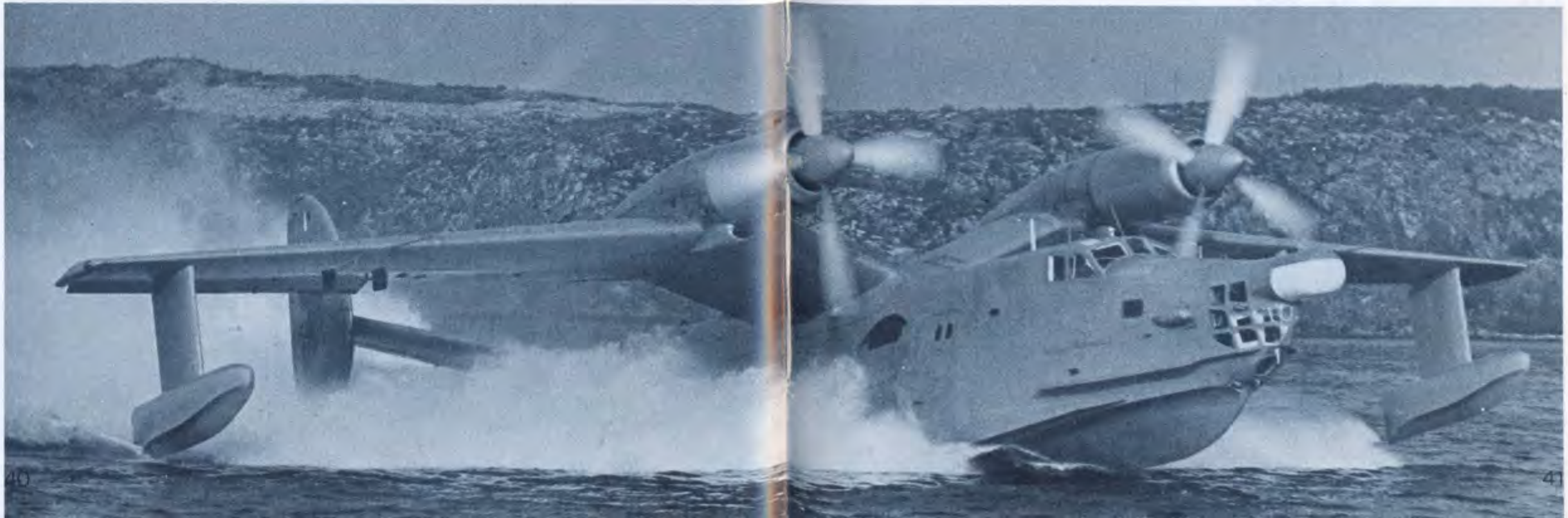
Like the Be-6 the high-mounted wing is of the so-called 'gull' form with acute dihedral inboard to raise the four-blade reversing propellers clear of waves and spray. This wing centre-section has constant chord, unlike the Be-6, and the engines are mounted further outboard, on the tapered outer wings, to give considerable clearance between the blades and the hull. The latter is longer than that of the Be-6 and offers increased working space for the crew of from four to nine (depending on mission). In the nose is a glazed navigation and observation station with electrically heated windows, and an A304-series radar projects in a long thimble radome from the top of the bow. The flight deck seats two pilots side-by-side and there are usually

Above: M-12 wing centre-section has parallel chord.

stations for a radar/ESM officer, engineer and ASW operator, the latter in the rear fuselage (which has a glazed dome in the roof). Side hatches permit reloading the sonobuoy racks whilst the aircraft is afloat, and it is believed that depth bombs and other smaller stores can be carried in the internal bay and dropped through doors in the aft planing bottom. An APU (auxiliary power unit) with a small gas turbine is installed immediately ahead of the tail. For land operations a tailwheel-type landing gear is installed, all units retracting upwards into the hull. The outer wings carry fixed stabilizing floats.

At least 100, and possibly more than 200, of these versatile amphibians were delivered in 1965-72, for service with the Red Banner Northern, Baltic, Black Sea and Pacific Fleets. In 1982 about 80 remained in service, from about 12 main shore stations, on maritime patrol, ASW, ESM, Elint and rescue missions, occasionally being required to go up into the Arctic for rescue or mission-support duties. Standard AVMF examples set numerous world class records in various flights in 1964-78, including all 21 in the turboprop amphibian class. On one a height of 39,977ft (12,185m) was attained, and on another a useful load (excluding fuel) of 22,266lb (10.1t) was uplifted. Though no comparable aircraft (excluding eight Japanese amphibians) exist elsewhere, the M-12 has proved so useful that a successor is almost certainly being built, and may be flying.

Below: This takeoff picture shows how well the gull wings—hence popular name Tchaika (Seagull)—keep propellers above the spray.

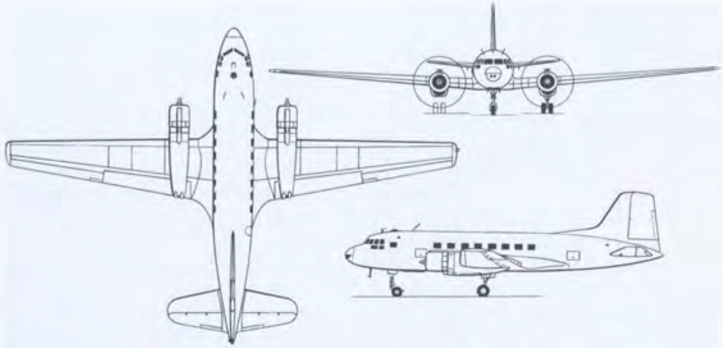


Ilyushin Il-14

Il-14, 14T, 14M and ECM version

Origin: The OKB of Sergei V. Ilyushin.
Type: Originally, passenger or cargo transport; today, also ECM/Elint.
Engines: Two 1,900hp Shvetsov ASh-82T 18-cylinder.
Dimensions: Span 104ft 0in (31.69m); length 69ft 11in (21.31m), (14M) 73ft 2in (22.3m); wing area 1,075sq ft (99.7m^2).
Weights: Empty (early, typical) 27,557lb (12.5t), (M) 27,955lb (12,680kg); payload, varies with version from 6,614lb (3t) to 7,275lb (3.3t); loaded, 38,580lb (17.5t), (14M) 39,683lb (18t).
Performance: Maximum speed 268mph 431km/h), (14M) 259-mph (417km/h); typical cruising speed 193mph (310km/h); initial climb (14M) 1,220ft (372m)/min; service ceiling (typical) 22,966ft (7km); takeoff run (typical, paved runway), 1,591ft (485m); range with max payload (typical) 248.5 miles (400km); range with max fuel (typical) 1,087 miles (1,750km).
Armament: None.
History: First flight 1950; service delivery 1954.

Development: The Il-14 was developed over a considerable period in an attempt to cure most of the faults and deficiencies of the closely similar Il-12, but even though the new machine was safer and easier to fly it was, by Western standards, totally uneconomic. A tough stressed-skin machine, it was in most respects larger than the 52/60-seat CV-440 but carried only 18 to 26 passengers until further extensive modifications were made. Among the latter were the stretched forward fuselage of the Il-14M of 1958 which seated first 30 and then 36. In addition to a reported Soviet production total exceeding 3,500 of numerous versions, smaller numbers were made in East Germany and Czechoslovakia. The Il-14 served in very large numbers in the VTA and other branches of the Soviet armed forces, mainly as a personnel or cargo transport but also as a navigation, radio and EW/ECM trainer. It is believed that the type has been phased out of VTA transport regiments, though large numbers continue in the inventory in a second-line status. Since 1979 numbers of an ECM/Elint version with rows of electronic aerials along the top and bottom of the fuselage have been seen with the VVS in East Germany and in other theatres. Designation of these rebuilds is unknown. Most feature a large bulged aerial and/or an observation blister on the left side (sometimes, on both sides) of the forward fuselage.



Above: Three-view drawing of the Ilyushin Il-14M passenger aircraft.

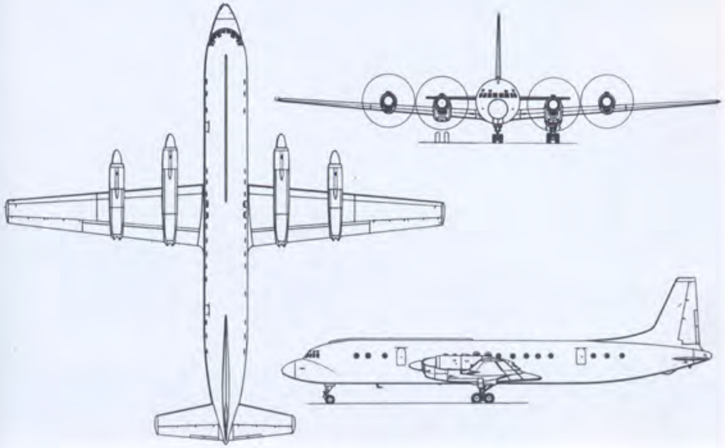
Below: An Il-14T of the VVS, construction number 4340302; this is a cargo conversion with metal floor and large doors on the left side.

Ilyushin Il-18

Il-18, 18V, 18D and 'Coot-A'

Origin: The OKB of Sergei V. Ilyushin.
Type: Originally passenger transport, ('Coot-A') multi-sensor reconnaissance and ECM.
Engines: Four 4,250ehp Ivchyenko AI-20M single-shaft turboprops.
Dimensions: Span 122ft 8½in (37.4m); length 117ft 9⅓in (35.9m); height 33ft 4in (10.17m); wing area 1,507sq ft (140m^2).
Weights: (18D, typical) empty 77,600lb (35.2t); maximum payload 29,750lb (13.5t); maximum takeoff 141,095lb (64t).
Performance: (18D) Maximum cruising speed 419mph (675km/h); normal cruise 388mph (625km/h); typical cruise altitude 26,250/32,800ft (8/10km); takeoff run 4,265ft (1.3km); landing run 2,790ft (850m); range (max payload, 1h reserve), 2,300 miles (3,700km), (max fuel, 1h reserve),▶

Right: Three-view of the Ilyushin Il-18D, a late passenger variant.



▶ 4,040 miles (6,500km).
Armament: None.
History: First flight 4 July 1957; service delivery 1959, ('Coot-A') probably about 1977.

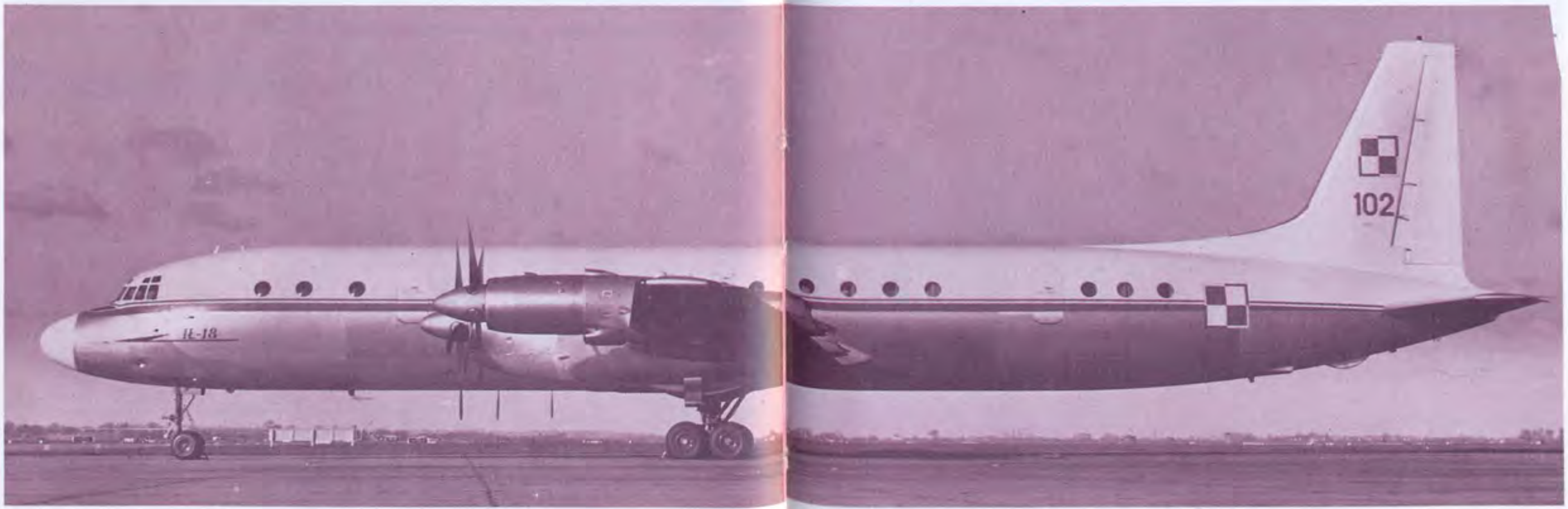
Development: The Il-18, originally named Moskva (Moscow), was a completely fresh design to serve on Aeroflot's major trunk routes in response to a 1953 specification calling for 75/100 passengers, high speed, long range, pressurization and the ability to operate from unpaved airstrips. The resulting aircraft proved efficient, with a circular-section fuselage, 14%-thick unswept wing with the four engines mounted fairly high to discharge via tailpipes across the upper surface, electro-thermal de-icing, hydraulic double-slotted flaps and bogie landing gears, manual flight controls, and fuel capacity of 5,213 Imp gal (23,700lit) in integral outer wings and ten flexible cells inboard. The cabin is 79ft 0in (24.0m) long, excluding the flight deck, and 127in (3.23m) wide internally. Early aircraft seated 75 passengers 3+2, but this was increased to 84 and then 110, 3+3, while in the 18D of 1965 the engine power was increased (from 4,000ehp) and fuel capacity raised to 6,600gal (30,000lit) by adding further cells in the centre section. The standard 110-seater has a flight crew of five, with comprehensive avionics including Emblema weather radar, and three passenger compartments seating 24 (3+3), 71 (3+3 except the last row 3+2) and 15 (3+2).

The Il-18 was the first major Soviet aircraft to find a wide export market, and at least 700 (probably about 800) were built. Of these some dozens were supplied to the Soviet armed forces, mainly the VTA and VVS staff, principally in the role of strategic VIP and personnel transports (for example, different examples have been used to pick up returned Cosmonauts and fly them to base or to reception at the Kremlin). After 1975 surplus civil Il-18s began to be converted as freighters, and a number were also rebuilt as major reconnaissance and ECM platforms. It is believed that, as in the case of the An-12, there is also an Elint version, but as this book went to press such an aircraft had not been identified.

The designation of the ECM variant is not known in the West, and NATO calls it 'Coot-A'. The modifications are very extensive and clearly result in a multi-sensor reconnaissance and stand-off jammer platform of great power and endurance (though of course it could not accompany attack aircraft into defended airspace). The largest sensor, which appears to be a SLAR (side-looking aircraft radar) of exceptional size and thus long wavelength and fine discrimination, is housed in a giant pod about 34ft (10.25m) long under the forward fuselage, with scanning to both left and right of the ventral centreline. Two other large fairings, each some 14½ft (4.4m) long, are attached along the sides of the forward fuselage, with a hatch in the front half of each fairing. The rest of the fuselage bristles with flush aerials, blade and whip aerials and small projecting dielectric domes, some of them similar to those carried by the ECM/Elint version of the Il-14.

Above: Takeoff by an Il-18 commercial transport of Interflug, the airline of the DDR; the smoky trails are also a feature of the An-12.

Below: Several air forces use the Il-18 in the transport role, this example being in service with the PWL (the Polish air force).

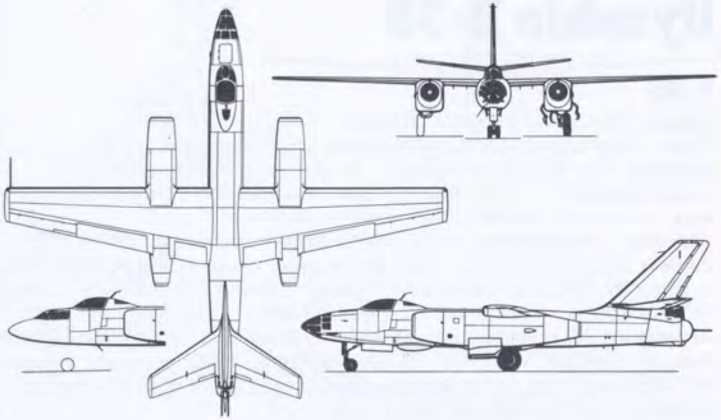


Ilyushin Il-28

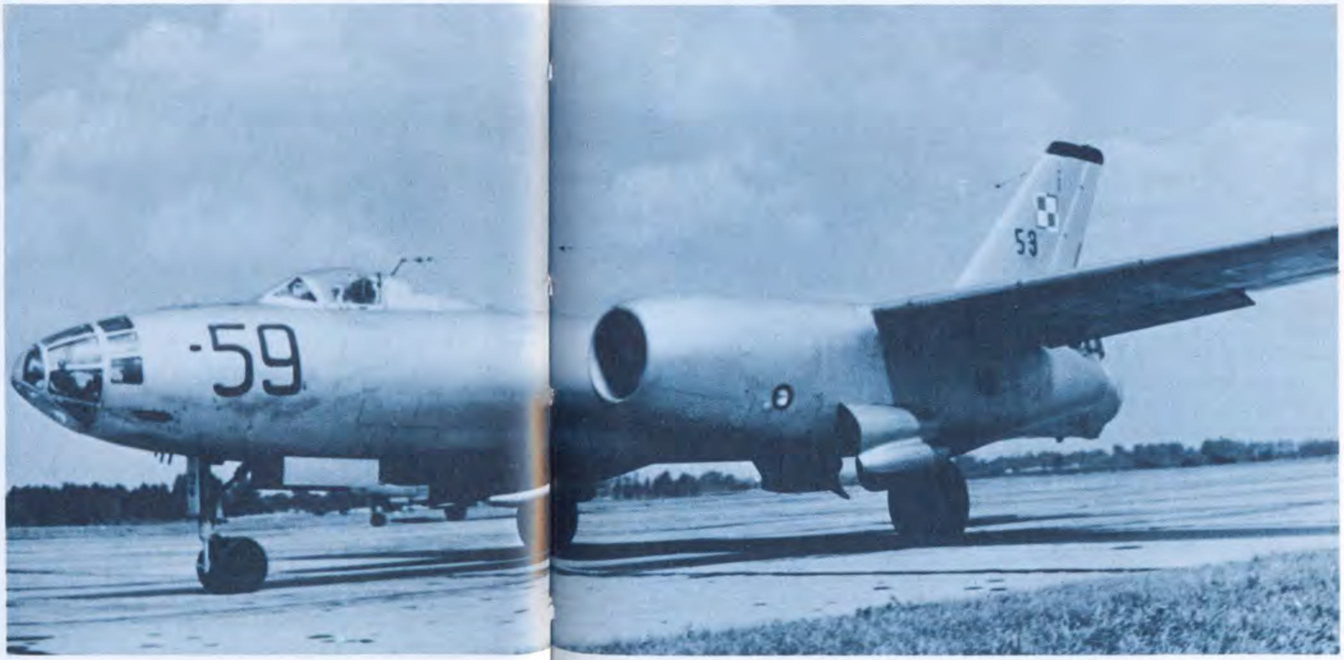
Il-28, 28R, 28T, 28U

Origin: The OKB of Sergei V. Ilyushin.
Type: Today, training and secondary duties, see text.
Engines: Two 5,952lb (2.7t) thrust Klimov VK-1 turbojets.
Dimensions: Span (excluding tip tanks) 70ft 4½in (21.45m); length (typical) 57ft 10¾in (17.65m); wing area 654.4sq ft ($60.8m^2$).
Weights: (original bomber) empty 28,417lb (12.89t); loaded (normal) 40,565lb (18.4t), (maximum) 46,296lb (21t).
Performance: (Original bomber) maximum speed, 559mph (900km/h) at 14,765ft (4.5km), 497mph (800km/h) at sea level; normal cruising speed at around 20,000ft (9km), 472mph (760km/h); initial climb 2,950ft (900m)/min; service ceiling 40,354ft (12.3km); takeoff run (normal loaded weight), 2,871ft (870m); landing run, 3,839ft (1,170m); range with maximum fuel (32,800ft/10km), 1,355 miles (2,180km), (3,280ft/1km) 705 miles (1,135km).
Armament: Normal bomb load 2,205lb (1t), maximum 6,614lb (3t); two NR-23 guns in tail turret, two NR-23 fixed firing ahead; (28T) two AV-45-36 short torpedoes; (28R) tail turret only; (28U) none, or tail turret only.
History: First flight 8 August 1948; service delivery, late 1950.

Development: Selected on the basis of unanimous pilot preference over a larger and in some ways more capable Tupolev rival, the Il-28 was an extremely simple machine based on the rapidly developed Soviet improved version of the Rolls-Royce Nene engine, installed in underwing nacelles which also housed the retracted single-wheel main gears. The unswept wing was structurally made in upper and lower halves, bolted together after completing the interior, but the large tail was swept to eliminate compressibility problems. Unlike the broadly similar British Canberra the Il-28 was burdened with a rear turret, one of a series produced by the Ilyushin OKB for several Soviet bomber aircraft of the immediate post-war era and fitted with two extremely powerful 23mm cannon. This required a gunner as well as the pilot, in a fighter-type cockpit with ejection seat, and the navigator in the glazed nose. A mapping/bombing radar was installed between the nose gear and the bomb bay. The Il-28R was a reconnaissance model, initially fitted with cameras only but later updated with other sensors. The 28T was a torpedo-bomber of the AVMF, and all branches used the dual Il-28U trainer with the pupil cockpit replacing the navigator's glazed nose. Of several thousand built, some hundreds remain airworthy, serving as advanced trainers, carry-trials aircraft, meteorological aircraft, target tugs and as remotely piloted vehicles for use as targets and in various research and trials programmes.



Above: Three-view of Il-28 with inset nose of Il-28U.



Right: In its day a direct counterpart to the British Canberra, the Il-28 was put into production after VVS bomber crews had unanimously expressed their preference for it over a seemingly more capable Tu prototype. Like its British rival the Il-28 has enjoyed a long and mainly troublefree career because of its basic simplicity. Large numbers are used—by most WP air forces, this example being Polish—for second-line duties of which a selection are listed on page 47.

Ilyushin Il-38

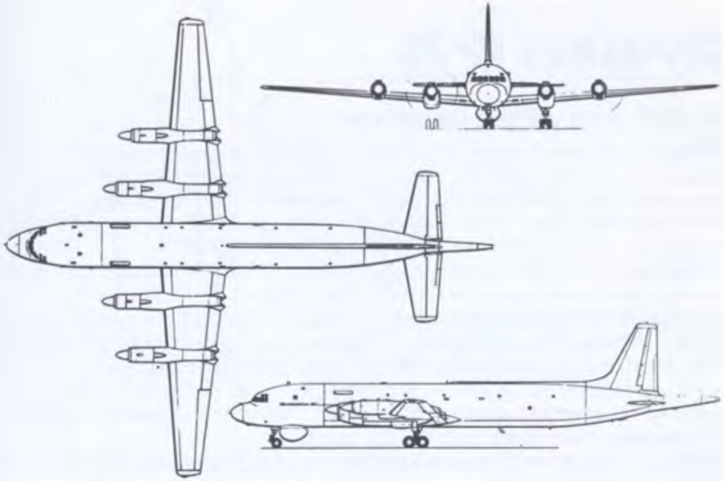
Il-38

Origin: The OKB of Sergei V. Ilyushin.
Type: Long-range shore-based maritime patrol and ASW aircraft.
Engines: Four 4,250ehp Ivchyenko AI-20M single-shaft turboprops.
Dimensions: Span 122ft 8½in (37.4m); length 129ft 10in (39.6m); wing area 1,507sq ft (140m²).
Weights: (Estimated) empty 80,470lb (36.5t); loaded 143,300lb (65t).
Performance: (Estimated) maximum cruising speed, 400mph (644km/h) at about 27,000ft (8.23km); patrol speed, 200mph (322km/h) at 1,000ft (300m); maximum range 4,500 miles (7,240km); loiter endurance 12h.
Armament: Main weapon bay immediately ahead of wing box in underfloor area of fuselage, with twin outward-opening doors; possible weapon stowage in rear internal bay or on underwing pylons, but no firm evidence.
History: First flight possibly about 1971.

Development: Based on the Il-18 transport, the Il-38 may in fact be rebuilds of aircraft withdrawn from service with Aeroflot, though the weight of evidence is that they were newly built in the 1970s. In a conversion process exactly akin to that which turned the civil Lockheed Electra transport into the P-3 Orion, the Ilyushin OKB turned the Il-18 into the Il-38 maritime patrol and anti-submarine aircraft. The fuselage is unchanged in cross-section, and no deep lower lobe has been added to house weapons and sensors. Instead weapons—AS torpedoes, mines, depth bombs and normal anti-ship bombs—are accommodated in the shallow space under the floor ahead of the wing. There has been considerable speculation that there are four hardpoints on the wing for external stores pylons, which would enable rockets to be fired and air/surface missiles to be launched, but such external stores or pylons have not been seen. An alternative explanation is that the internal bay extends to full depth of the fuselage, with walkways past it on each side. This would enable the weapon load to reach the kind of level (6,600 to 13,200lb, 3t to 6t) expected for an aircraft of this size and power, and would also help explain the extraordinary forward shift of the wing, relative to the Il-18, which could not possibly be accounted for by the mass of the extra radar under the forward fuselage. At the same time, a large weapon load ahead of the wing would result in a gross change in centre of gravity position when the stores were dropped.

The Il-38 was first disclosed in 1971, by which time it was well established in service with the AVMF. A widespread report that the first example flew in 1967 and that the definitive Il-38 entered service in 1970 may well be true, though again evidence is lacking. The fuselage is almost certainly pressurized, and has few windows, though it is reasonable to suppose there is a large tactical compartment amidships (which in this aircraft means behind the wing) with navigation and attack displays and readouts from the various types of sensor. Ducts on each side of the forward fuselage probably draw in and expel air to 'sniff' for traces of diesel smoke. The rear fuselage certainly houses a store of sonobuoys, dropped through a tube and fired from a retrolauncher (which cancels aircraft speed so that the buoy drops straight down), but most drops observed by RAF and US aircraft have been from the main weapon bay whose large doors have to be opened for the purpose. In the extreme tail is a MAD installation which accounts for most of the extra length, compared with the Il-18. The added radar is not the same as that of the Ka-25 variant called 'Hormone-B', though the radome looks similar.

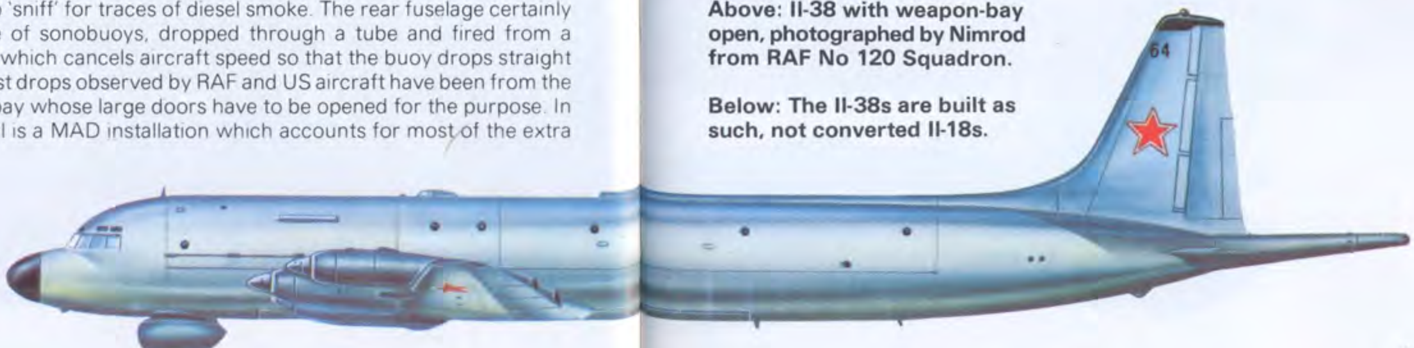
Altogether the Il-38 presents several puzzles, one being its cleanliness and apparent lack of avionics aerials and weapons. Its range and endurance are not in question, and its overall efficiency is presumably confirmed by a sale to India. The best Western guess of the number in use by AVMF units is only 60, a trivial number bearing in mind the extent of coastline, ocean and Arctic ice that these aircraft need to keep under surveillance.



Above: Three-view of Il-38 (no variants are known).

Above: Il-38 with weapon-bay open, photographed by Nimrod from RAF No 120 Squadron.

Below: The Il-38s are built as such, not converted Il-18s.

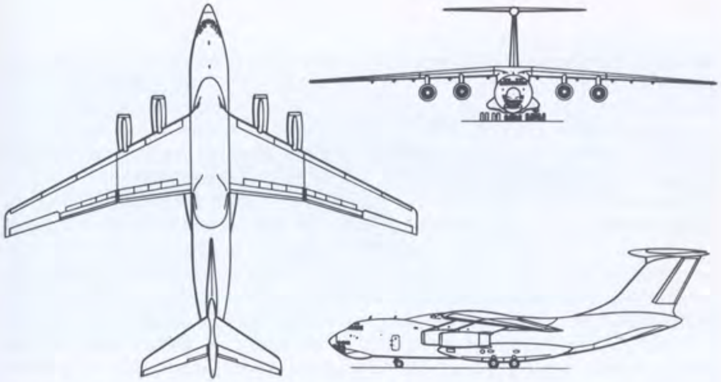


Ilyushin Il-76

Il-76T and other variants

Origin: The OKB of Sergei V. Ilyushin, under General Designer Novozhilov.
Type: Heavy cargo airlifter, air refuelling tanker, Awacs platform.
Engines: Four 26,455lb (12t) thrust Soloviev D-30KP turbofans.
Dimensions: Span 165ft 8in (50.5m); length 152ft 10½in (46.59m); height 48ft 5in (14.76m); wing area 3,229sq ft (300m²).
Weights: (basic transport) empty, about 176,400lb (80t); maximum payload 88,185lb (40t); load 374,785lb (170t).
Performance: Maximum speed 528mph (850km/h); cruising speed 466/497mph (750/800km/h); normal cruising height 29,500/39,370ft (9/12km); takeoff run (paved runway) 2,790ft (850m); landing run 1,475ft (450m); range with maximum payload, 3,100 miles (5,000km); range with maximum fuel 4,163 miles (6,700km).
Armament: Twin guns (NR-23 ?) in tail turret.
History: First flight 25 March 1971; service delivery (evaluation), believed 1973, (inventory) 1975.

Development: Bearing a striking resemblance to the American C-141A, the Il-76 is in fact larger, heavier and much more powerful. It does not carry more, nor have a longer range, but instead uses its power to achieve a short rough airfield capability never before equalled for an airlifter of this size and weight. The basic requirement, dating from about 1965, was again a civil one. The need was for an airlifter to replace the An-12 in carrying heavy and bulky loads from austere airstrips in opening up important areas (such as the Tyumen oil region) of Siberia and other undeveloped regions of the Soviet



Above: Three-view of Il-76T (civilian, without turret).

Union. The Il-76 had to fly in extremely adverse weather, cruise faster than the An-12 but at lower unit-transport cost and be simple to service. The baseline mission was the carriage of 40 tonnes of freight 5,000km in less than 6h.

All these requirements carried across directly to the military VTA, and though the prototypes (at least those seen in the outside world) were all civil, the military potential was studied carefully from the drawing board stage, and in conformity with a long-lived (and rather surprising) tradition provision was made for an Ilyushin tail turret with radar gunlaying and a human gunner; it is believed to mount two NR-23 cannon. The avionics required fully to meet the civil specification were exceptionally comprehensive and ▶

Left: An Aeroflot Il-76 parked next to an Il-62M. These aircraft have broadly similar types of engine and closely comparable gross weights, but differ markedly in their design because of their contrasting payloads (passengers or cargo) and field requirement (long concrete runways against short unpaved strips). The Il-76 is now being produced as a military tanker and also, it is believed, as the future standard AWACS-type surveillance platform for the VVS.

Below: An early Il-76 in military service, without turret (which is fitted to some civil examples!).

▶include a computer for automatic trajectory control including automatic landings (at runways with sufficiently good ILS). The nose resembles that of the An-22 in having a large weather radar facing ahead and an even larger mapping radar in the chin position which assists in identifying targets for precision airdrops. As usual, there is a fully glazed nose compartment for the navigator. Normal flight crew is five, plus two freight handlers.

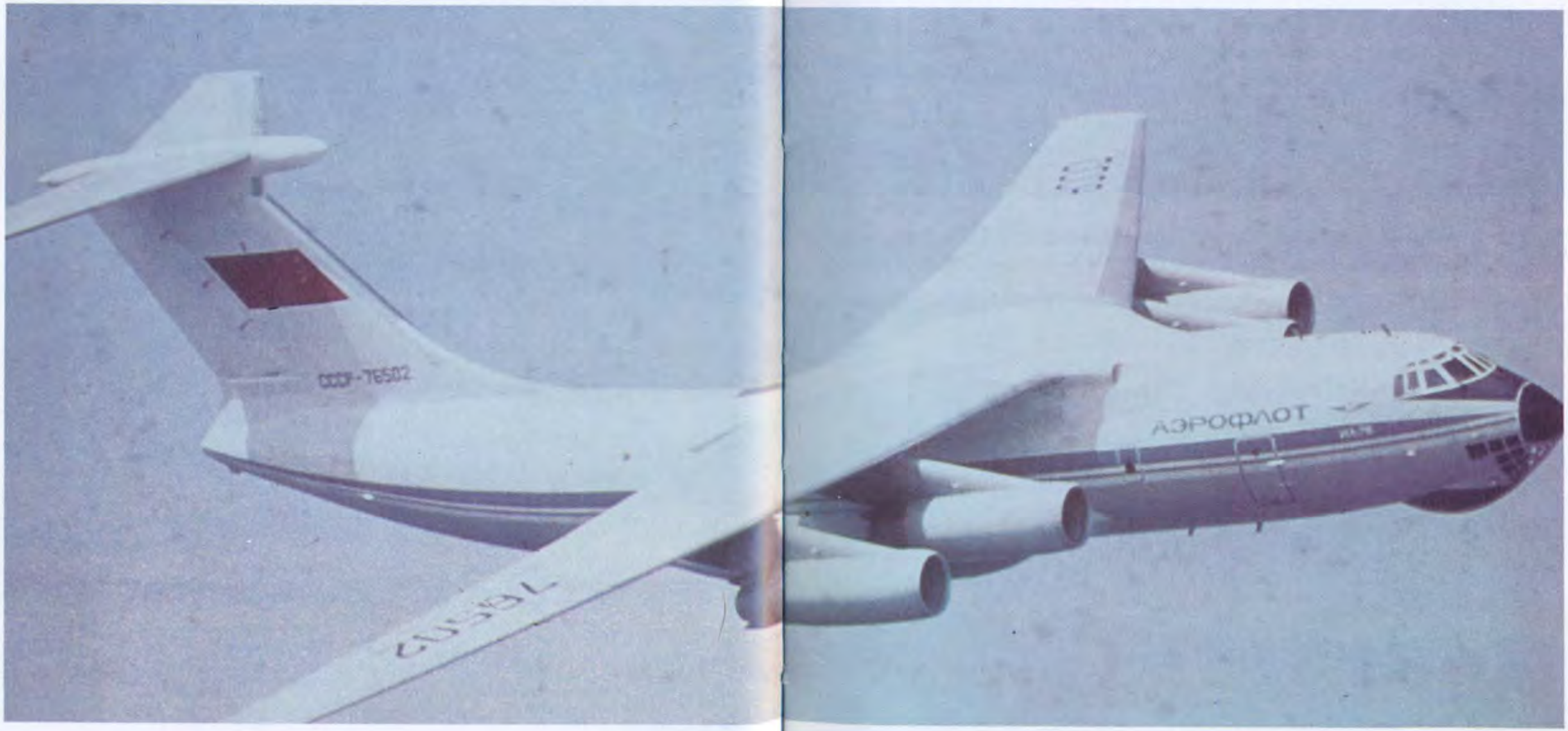
The main cabin is 65ft 7⅓in (20.0m) long internally, or 80ft 4½in (24.5m) including the rear ramp, and has a width of 11ft 1¾in (3.40m) and ruling height of 11ft 4¼in (3.46m). The entire volume is pressurized, and the rear ramp and twin aft doors allow the loading of a very wide range of wheeled or tracked vehicles or all normal sizes of container or pallet. Cargo is handled by a 66,140lb (30t) capacity lift on the rear ramp and four hoists each rated at 5,511lb (2.5t) running the full length of the cabin on gantry rails. Normal seating in the trooping role is 140. Though the normal load is 40t, as given in the data, Il-76s have set numerous world speed and height records with loads up to 70t (154,321lb). Another remarkable world record was the dispatch of a stick of parachutists at 50,479ft (15,386m) altitude, one of the greatest heights reached by a subsonic transport. Engineering features include reversers on all four engines and a total of 20 landing wheels to spread the load on soft soil, gravel, sand or compacted snow. Tyre pressure can be adjusted to a suitable preset value before landing.

Though about half the first batches went to the GVF for Aeroflot use, about 140 Il-76T transports had been delivered to the VTA by the start of 1981 and about a further 12 were received in that year. Included towards the end of 1981 were the first air-refuelling tanker versions (designation unknown), which were developed after prolonged trials with a modified 76T in 1978 or 1979. It is expected that the tanker Il-76 will replace the M-4 in this role by 1984 in both the ADD and AVMF, each aircraft having a secondary transport role. A third and extensively modified version is

Above: Compared with the otherwise similar USAF C-141 the Il-76 makes much greater effort to use short rough airfields; engines are more powerful, and the flaps and high-flotation landing gear help.

intended to supplement and eventually replace the Tu-114 as the standard Awacs (airborne warning and control system) platform. Several new Il-76 aircraft (designation unknown) were being completed in lae 1981 with a large rotordome on a pylon above the wing; other major changes include an extended forward fuselage and a flight-refuelling probe (a fitment allowed for, but not always fitted, to the military Il-76T). It has been guessed that at least 50 of the Awacs surveillance version will be operational by 1985.

Below: Another civilian Il-76. Western students of Soviet aircraft did not in early 1982 know the differences between this and the Il-76T and Il-76M, all of which are widely used cargo versions.

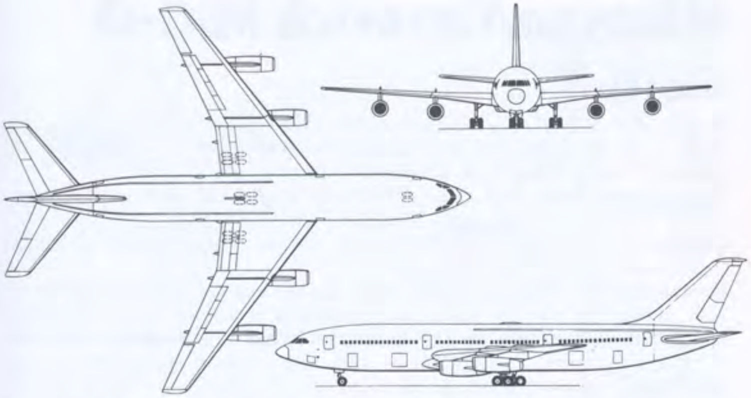


Ilyushin Il-86

Il-86

Origin: The OKB of Sergei V. Ilyushin, under General Designer Novozhilov.
Type: High-capacity passenger transport.
Engines: Four 28,660lb (13t) thrust Kuznetsov NK-86 turbofans.
Dimensions: Span 157ft 8¼in (48.06m); length 195ft 4in (59.54m); height 51ft 10½in (15.81m); wing area 3,444sq ft (320m²).
Weights: Empty about 205,000lb (93t); maximum payload 92,600lb (42t); maximum loaded 454,150lb (206t) (or less, depending on runway).
Performance: Maximum cruising speed 590mph (950km/h) at 36,100ft (11km); normal cruising speed 560mph (900km/h) at 30,000ft (9km); field length (normal weight, SL), 8,530ft (2.6km); range with 88,185lb (40t) payload, 2,235 miles (3,600km); range with maximum fuel, 2,858 miles (4,600km).
Armament: None known.
History: First flight 22 December 1976; service delivery (civil) late 1979, (military) not known.

Development: After a long period of parametric studies this very large passenger liner for Aeroflot trunk rotes finally emerged with a traditional 707-type configuration, with a 35° wing and four widely spaced underwing engines. The finely streamlined fuselage has a circular section of 19ft 11½in (6.08m) diameter, providing for typical accommodation of 350 passenger in 3+3+3 seating. It is the first twin-aisle 'wide-body' aircraft designed in the Soviet Union. One of the factors strongly influencing its design is the need to be to a large degree independent of the long paved runways and lavishly equipped terminals common in Western countries. The engines all have reversers, the three large bogie main gears are matched to rough unpaved runways, the APU (auxiliary power unit) in the tailcone makes the Il-86 independent of ground power, and most unusual of all is the arrangement of stairways for passenger off-loading and boarding. Three powered air airstairs from the ground lead to the lower deck, where large areas are set aside for passengers to stow or retrieve hand luggage and coats. Further stairways then lead up to the main deck. This feature dramatically increases the value of the Il-86 as a military troop transport. In time of emergency the entire GVF (civil air fleet) is placed at the disposal of the VVS high command, and the Il-86 not only has capacity far exceeding any previous Soviet passenger aircraft but its complete independence of airport services enables it to put down large forces anywhere there is a runway (paved or not) of suitable length and strength. A large group of factories in the Soviet Union and Poland is producing the Il-86 at a high rate. It is reported that in 1982-83 a longer-range (3,725-mile, 6,000km) model would enter production.



Above: Three-view of standard Il-86 passenger transport.

Above: The first prototype Il-86 was exhibited at the Paris airshow in June 1977, six months after its maiden flight at Moscow Khodinka.

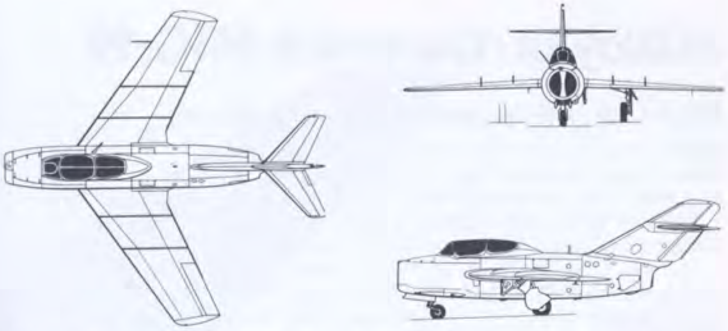
Below: Compared with most recent Soviet transports the Il-86 has completed its development quite quickly; this is a production Il-86.

Mikoyan/Gurevich MiG-15

MiG-15UTI

Origin: The OKB of A. I. Mikoyan and M. I. Guryevich.
Type: (UTI) advanced pilot and weapons trainer.
Engine: One 5,952lb (2,7t) Klimov VK-1 turbojet.
Dimensions: Span 33ft 0⅞in (10.08m); length 32ft 11¼in (10.04m), height 12ft 1⅝in (3.7m); wing area 221.74sq ft (20.6m^2).
Weights: Empty (typical) 8,820lb (4t), loaded (clean) about 10,935lb (4,960kg); maximum 11,905lb (5.4t).
Performance: Maximum speed (clean, SL) 630mph (101km/h), falling off with increasing altitude, (with two 55gal/250lit slipper tanks) 559mph (900km/h); initial climb 10,450ft (3,185m)/min; service ceiling 47,980ft (14,625m); range at 32,800ft (10km) with slipper tanks, 885 miles (1,424km).
Armament: one 12.7mm UBK-E gun with 120/150 rounds or one NS-23 with 80 rounds; underwing load of up to 500kg (1,102lb) various stores as additions to slipper-type drop tanks usually of 55gal (250lit) size.
History: First flight (prototype fighter) 30 December 1947, (UTI) believed late 1949; service delivery (fighter) October 1948, (UTI) mid-1950.

Development: For 30 years the MiG-15UTI, in various forms, has been the standard advanced trainer of all the Warsaw Pact countries, and large numbers were built elsewhere under licence and exported. The original MiG-15 fighter was the production offspring of the MiG S or I-310, designed and built with amazing rapidity soon after World War 2. As finally agreed it had a wing of 11 per cent thickness swept at 35°, with a horizontal tail swept at 40° mounted high on a 56° (leading edge) fin. Features included a fixed



Above: Three-view of MiG-15UTI (drop tanks seldom fitted).

leading edge, plain outboard manual ailerons, inboard Fowler flaps, fixed tailplane, levered-suspension landing gear, pressurized cockpit with ejection seat and armament of three large-calibre cannon. Though it suffered from fairly serious deficiencies it was streets ahead of anything else in the world except the American F-86, and between 5,000 and 8,000 were built at a high rate. The tandem dual trainer MiG-15UTI was one of the first major variants, and total production of this model (included in the above total) eventually approximately equalled that of the fighter versions, at least 1,500 UTIs being produced as rebuilds. Some of the rebuilds were of the improved MiG-15bis fighter series with variable-incidence increased tailplane, internal fuel, different weapons, three hardpoints under each wing and many other changes. At first the bis series were the only variants with the VK-1 engine, replacing the Russian version of the Nene (RD-45), but all surviving UTIs have had this engine since the early 1960s.

Mikoyan/Gurevich MiG-17

MiG-17F, PF

Origin: The OKB of A. I. Mikoyan and M.I. Guryevich.
Type: Designated as (F) day fighter/bomber (PF) limited all-weather interceptor; now used as advanced trainers.
Engine: One Klimov VK-1F turbojet with afterburning rating of 7,452lb (3,380kg).
Dimensions: Span 31ft 7⅛in (9.63m); length (slight variations) 36ft 4⅜/4⅝in (11.09m); wing area 243.26sq ft (22.6m^2).
Weights: Empty (F, typical) 9,040lb (4.1t); loaded (clean) 11,772lb (5,340kg), (maximum) 14,440lb (6.55t).
Performance: Maximum speed (F) 710mph (1,145km/h, Mach 0.974) at 9,840ft (3km), falling off above and below; initial climb 12,795ft (3.9km)/min; service ceiling (typical, with afterburner) 52,500ft (16km); range (internal fuel, clean, 32,800ft/10km) 600 miles (970km); maximum range (two 88gal/400lit drop tanks) 913 miles (1,470km).
Armament: (F) usually three NR-23 plus various underwing ordnance loads to maximum of about 750kg (1,653lb) such as two FAB-250 bombs and two UV-16-57 rocket pods.
History: First flight (prototype) January 1950, (production 17F) October 1952.

Development: Though so superficially similar to the MiG-15 that it was not immediately identified in the West as a separate type, in fact the MiG-17 has totally new wings, rear fuselage and horizontal tail. It was designed to rectify the aerodynamic and other shortcomings of the original fighter, and

Above: Early MiG-17s (not 17Fs) of the AVMF with bordered insignia.

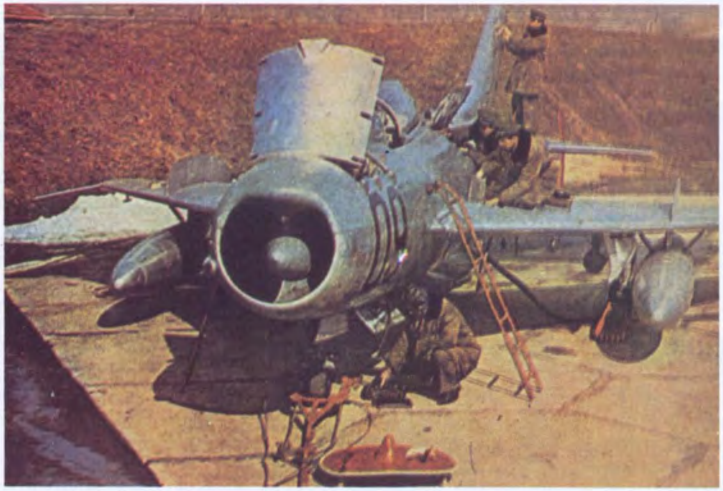
succeeded admirably, besides with the MiG-17F version introducing an afterburning engine giving significantly enhanced all-round performance. The PF was one of the first radar-equipped fighters in Soviet service (spring 1953) with a forward fuselage of greater length incorporating an Izumrud Al radar with scanners in the upper inlet lip and added central bullet, with racking for the main radar boxes ahead of the instrument panel. The windscreen in this version was raked more acutely and reinforced with additional framing. There were many other versions, altogether made in slightly greater numbers than the MiG-15. Many of the foreign users have modified versions (some Chinese-built), often with fuselage bomb racks or reconnaissance cameras. No MiG-17 front-line unit exists in the Soviet Union, but large numbers–F and PF models–remain flyable.

Mikoyan/Gurevich MiG-19

MiG-19S, SF; possibly other versions

Origin: The OKB of Artem I. Mikoyan.
Type: Fighter/bomber; today advanced trainer.
Engines: Two Tumanskii R-9B or BF augmented turbojets each rated at 5,732lb (2.6t) dry and 7,275lb (3.3t) with maximum afterburner.
Dimensions: Span 30ft 2¼in (9.2m); length 41ft 4in (12.6m), (including instrument boom) 48ft 10½in (14.9m); wing area 269sq ft (25.0m²).
Weights: Empty (S, typical) 12,125lb (5.5t), (SF) 12,698lb (5.76t); loaded (S) 16,535lb (7.5t), (SF) 16,755lb (7.6t); maximum overload (both) 19,180lb (8.7t). ▶

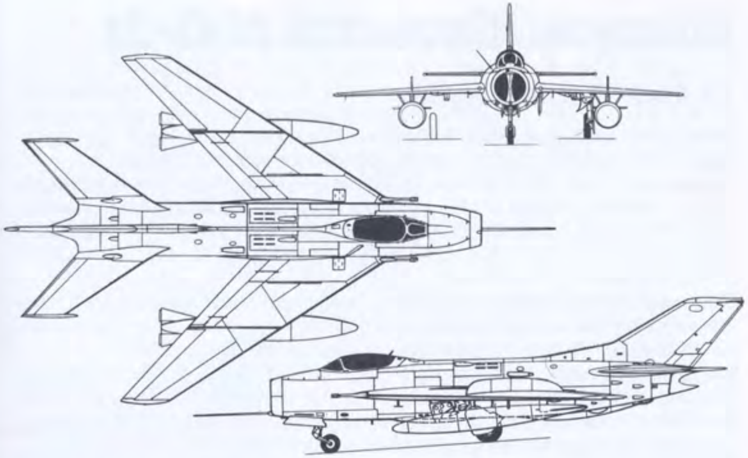
Below: Maintenance on a Bulgarian MiG-19PFM whose missile pylons have been removed.



Above/Below: Standard MiG-19SF day fighter bomber in a VVS colour scheme. The Soviet Union rather quickly replaced this by early MiG-21s.

▶**Performance:** Maximum speed (S, clean) 902mph (1,452km/h, Mach 1.35) at 32,800ft (10km); initial climb (S, clean) 22,640ft (6,900m)/min; service ceililng 58,725ft (17.9km); combat radius (hi-lO-hi, two 176gal/800lit drop tanks) 426 miles (685km); maximum range (two 334gal/ 1,520lit drop tanks) 1,366 miles (2,200km); takeoff run with afterburner 1,690ft (515m); landing speed 146mph (235km/h); landing run with drag chute 1,970ft (600m).
Armament: Two or three NR-30 cannon plus up to six external stores (usually light loads such as UV-16-57 rocket pods or Atoll AAMs).
History: First flight (SM) 18 September 1953, (production 19S) late 1954.

Development: Marking an almost complete break with all prior practice, this outstanding fighter family was a remarkably bold and successful design which showed that supersonic flight was possible with a normal high-aspect-



Above: Three-view of MiG-19SF with drop tanks.

ration swept wing with conventional outboard ailerons. The chosen engine comprised a pair of slim axial turbojets developed by Tumanskii's team at the Mikulin bureau (designated AM-5 until Mikulin's downfall in 1956 and RD-9 thereafter). These fitted side-by-side in the rear fuselage with pen-nib fairings between the jetpipes which in production aircraft had modulated afterburners with excellent multi-flap nozzles. The wings were fitted with single very large full-chord fences and Fowler flaps, and after studying a high tailplane the horizontal tail was moved to mid-way down the fuselage and finally at the top of the fuselage. Lateral control was improved by plate-type spoilers and longitudinal control by developing a one-piece slab tailplane on each side used as a fully powered control surface. In VVS service from late 1954, the MiG-19S was immediately extremely popular, but production in the Soviet Union was relatively modest, possibly a total of 2,500 of several production variants including AAM-armed all-weather interceptors. There were numerous two-seat or rocket/jet prototypes, and since 1960 other versions have been developed in China where production continued in 1981. No front-line MiG-19 regiments remain in the VVS inventory but almost all branches, including the AVMF, retain a few MiG-19S and SF fighters as advanced trainers in aerial gunnery and weapon delivery.

Above: Several later versions of MiG-19 had interception radar and in the PFM the final step was taken to replace the guns by early AAMs. This MiG-19PFM has four 'AA-1 Alkali' missiles. Right: Much more numerous, the MiG-19P was the first radar-equipped interceptor, with two NR-23 guns.

Mikoyan/Gurevich MiG-21

17 identified sub-types

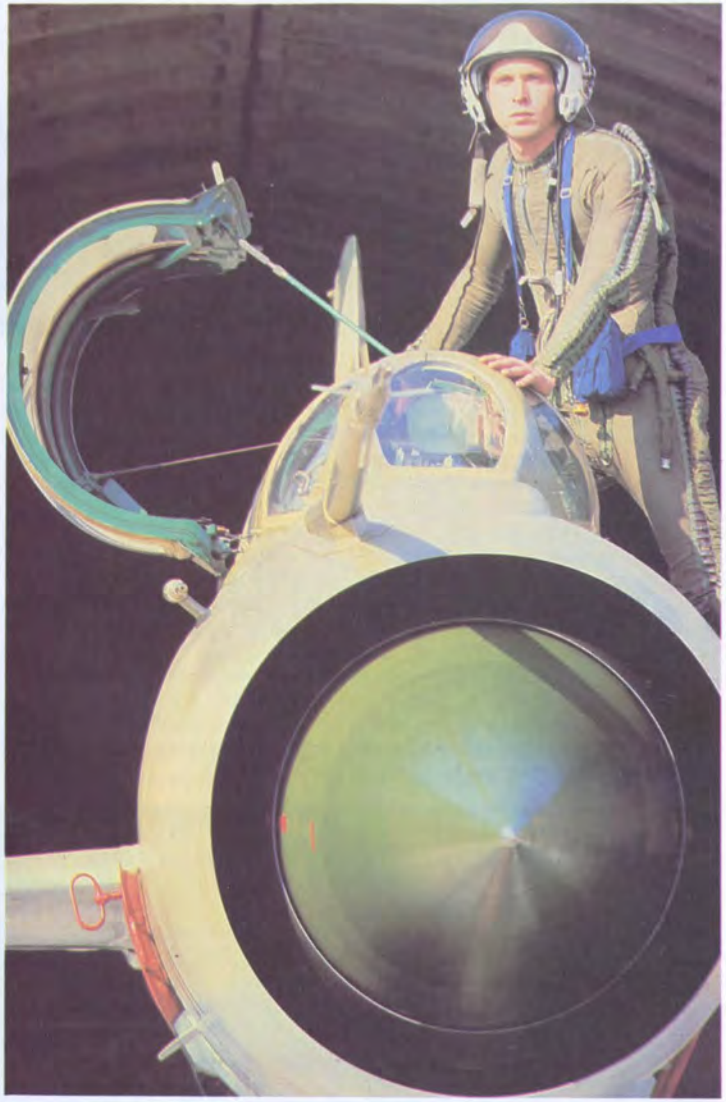
Origin: The OKB of Artem I. Mikoyan.
Type: (Most) fighter, (some) fighter/bomber or reconnaissance.
Engine: (21) one 11,243lb (5.1t) Tumanskii R-11 afterburning turbojet, (21F) 12,677lb (5.75t) R-11F, (21PF) (13,120lb) (5.95t) R-11F2, (21FL, PFS, PFM, US) 13,668lb (6.2t) R-11-300, (PFMA, M,R) R-11F2S-300, same rating, (MF, RF, SMT, UM, early 21bis) 14,550lb (6.6t) R-13-300, (21bis) 16,535lb (7.5t) R-25.
Dimensions: Span 23ft 5½in (7.15m); length (almost all versions, including instrumentation boom) 51ft 8½in (15.76m), (excluding boom and inlet centrebody) 44ft 2in (13.46m); wing area 247.57sq. ft ($23m^2$).
Weights: Empty (F) 12,440lb (5,643kg), (MF) about 12,300lb (5,580kg), (bis) 12,600lb (5,715kg); loaded (typical, half internal fuel and two K-13A) 15,000lb (6,800kg), (full internal fuel and four K-13A) 18,078lb (8,200kg); maximum (bis, two K-13A and three drop tanks) 20,725lb (9.4t).
Performance: Maximum speed (typical of all, SL) 800 mph (1,290km/h, Mach 1.05), (36,000ft/11km, clean) 1,385mph (2,230km/h, Mach 2.1); initial climb (F) about 30,000ft (9,144m)/min (bis) 58,000ft (17.68km)/min; service ceiling (bis, max) 59,055ft (18km); practical ceiling (all), rarely above 50,000ft (15.24km); range with internal fuel (F) 395 miles (635km), (bis) 683 miles (1,100km); max range with three tanks (bis 1,118km).
Armament: (21 and F) one (rarely two) NR-30 guns, two pylons for K-13A AAMs or UV-16-57 rockets, (FL and all subsequent) one GP-9 belly pack containing GSh-23 gun with 200 rounds and four wing pylons for K-13A, AS-7 or (possibly) AA-8 missiles, or up to 3,307lb I(1.5t) other loads including bombs, rockets or two 108gal (490lit) drop tanks. Belly pylon normally for drop tank only.
History: First flight (E-50) 1955, (E-6) 1957, service delivery (211) early 1958. ▶

Below: Still used in very large numbers by Frontal Aviation, the MiG-21SMT ('Fishbed-K') is typical of the later variants prior to the last (bis) series. Some of this variant have small wingtip pods housing ECM.

▶**Development:** Probably built in larger numbers than any other post-war monoplane and certainly in much greater quantity than any other modern combat aircraft, the MiG-21 began life as a very limited day fighter somewhat deficient in weapons and avionics, like the F-104A, which in exactly the same way had been created during the late part of the Korean war to incorporate the lessons of that conflict and achieve superior flight performance at almost any price. Unlike the F-104 the MiG-21 was ceaselessly improved for more than 20 years with better avionics and weapons and augmented fuel capacity so that, especially taking into account the very large numbers built, the MiG-21 has for 20 years been the Soviet Union's No 1 combat aircraft. Today it is reaching the end of its development and is giving way to larger and more capable aircraft with swing-wings and other new configurations, but MiG-21s of many versions will remain in Soviet service until the end of the century.

Shortly after the end of the Korean war the national aerodynamic research organization, TsAGI, selected two favoured configurations for future supersonic combat aircraft, the conventional swept wing (with quite high aspect-ratio) and swept horizontal tail and the delta with swept horizontal tail. In each case the leading-edge sweep was around 57° and the horizontal tail was a single 'slab' surface. The delta naturally had larger area, and offered lower wave drag and to some degree better manoeuvrability, though drag in▶

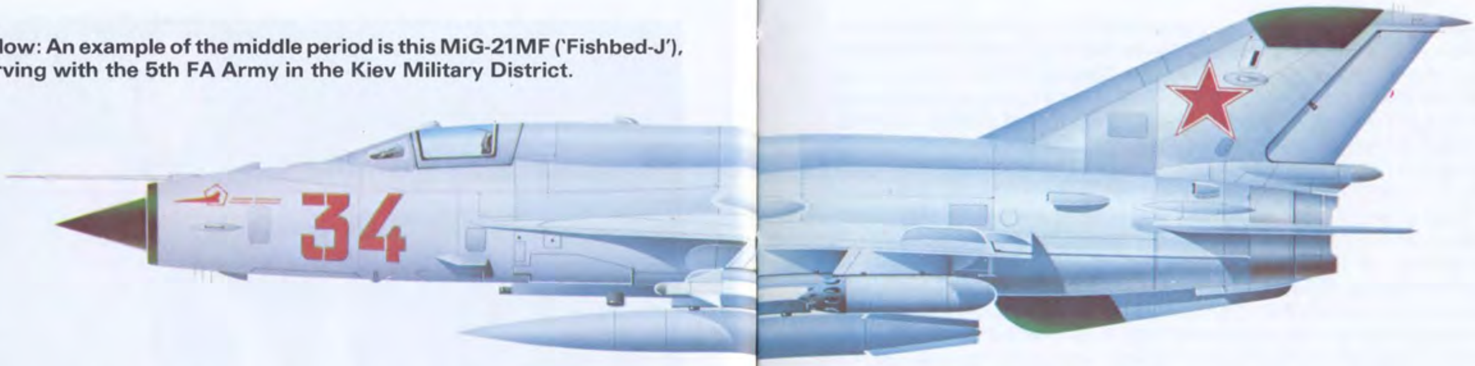
Above: Hundreds of MiG-21s of many variants are serving with the non-Soviet air forces of the Warsaw Pact; these are Polish FLs.



Above: A late-model MiG-21 with so-called 'Jay Bird' air intercept radar; it is almost certainly an R-25-powered MiG-21bis.

Left: One of the final production variants, this Frontal Aviation MiG-21 is of the bis series with the excellent R-25; in Trans-Baikal District.

Below: An example of the middle period is this MiG-21MF ('Fishbed-J'), serving with the 5th FA Army in the Kiev Military District.



▶tight turns was high so that sustained combat meant severe loss in speed. Despite this, after prolonged testing of the Ye-2A with swept wings and Ye-5 with the delta in 1955-57 the delta was chosen, and via the refined Ye-6 with the new R-11 engine the production MiG-21 emerged in late 1957 as a simple day fighter with 515gal (2,341lit) of internal fuel, provision for a 108gal (490lit) centreline drop tank and two NR-30 guns. Features included fully powered flight controls with slab tailplanes fitted with anti-flutter tip masses, single very small fences near the wingtips, area-increasing flaps (distantly related to the Fowler type), inwards-retracting main gears with the wheels (not levered-suspension) housed in the fuselage, a plain nose inlet with a small sliding centrebody housing a radar ranging gunsight, three airbrakes on the underside of the fuselage, a braking parachute (drag chute) on the underside of the rear fuselage with the cable anchored to the rear of a shallow ventral fin, and an unusual one-piece canopy over the pressurized cockpit forming a fairing over the pilot and an integral flat armoured windshield and pivoted at the front to continue to provide protection against the airstream during the sea ejection cycle.

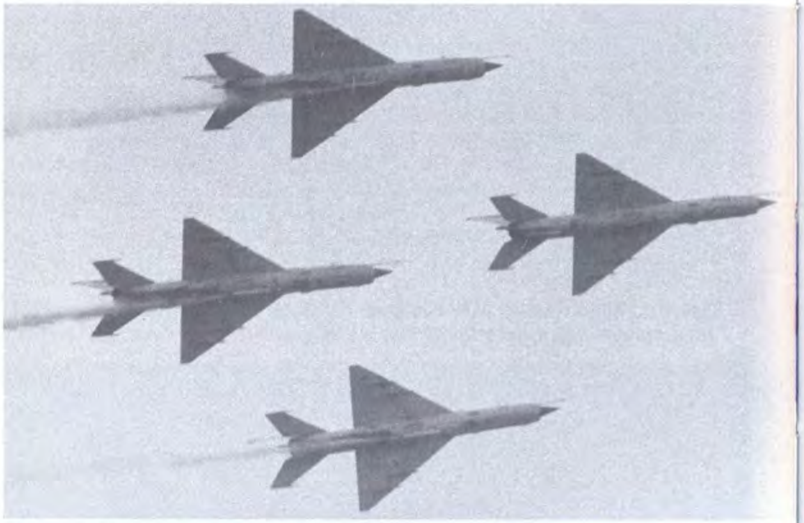
In 1958 the American Sidewinder AAM was copied to provide the K-13 (AA-2 Atoll) AMM, small pylons for two of these being added to the first major production MiG-21, the 21F, which also introduced a broader fin, more powerful engine and the option of carrying three tanks or various light loads of bombs or rocket pods. Usually the left gun was omitted. Large numbers of these continue in use as advanced trainers, mainly for aerobatics, supersonic techniques and weapon delivery. By 1960 production had switched to the PF with a further increase in power and a larger engine inlet duct made possible by a new forward fuselage of almost constant diameter, the resultant larger inlet (36in/910mm instead of 27in/690mm) providing room for a larger three-position centrebody housing the scanner of R1L ('Spin Scan') radar. The dorsal spine was enlarged to raise internal fuel to 616gal (2,800lit), the gun(s) were removed (simplifying the forward airbrakes), main tyres were increased in size (causing bulges above and▶

Below: These MiG-21MF 'Fishbed-J' fighters show that this earlier variant is being updated with the instrumentation avionics of the bis.

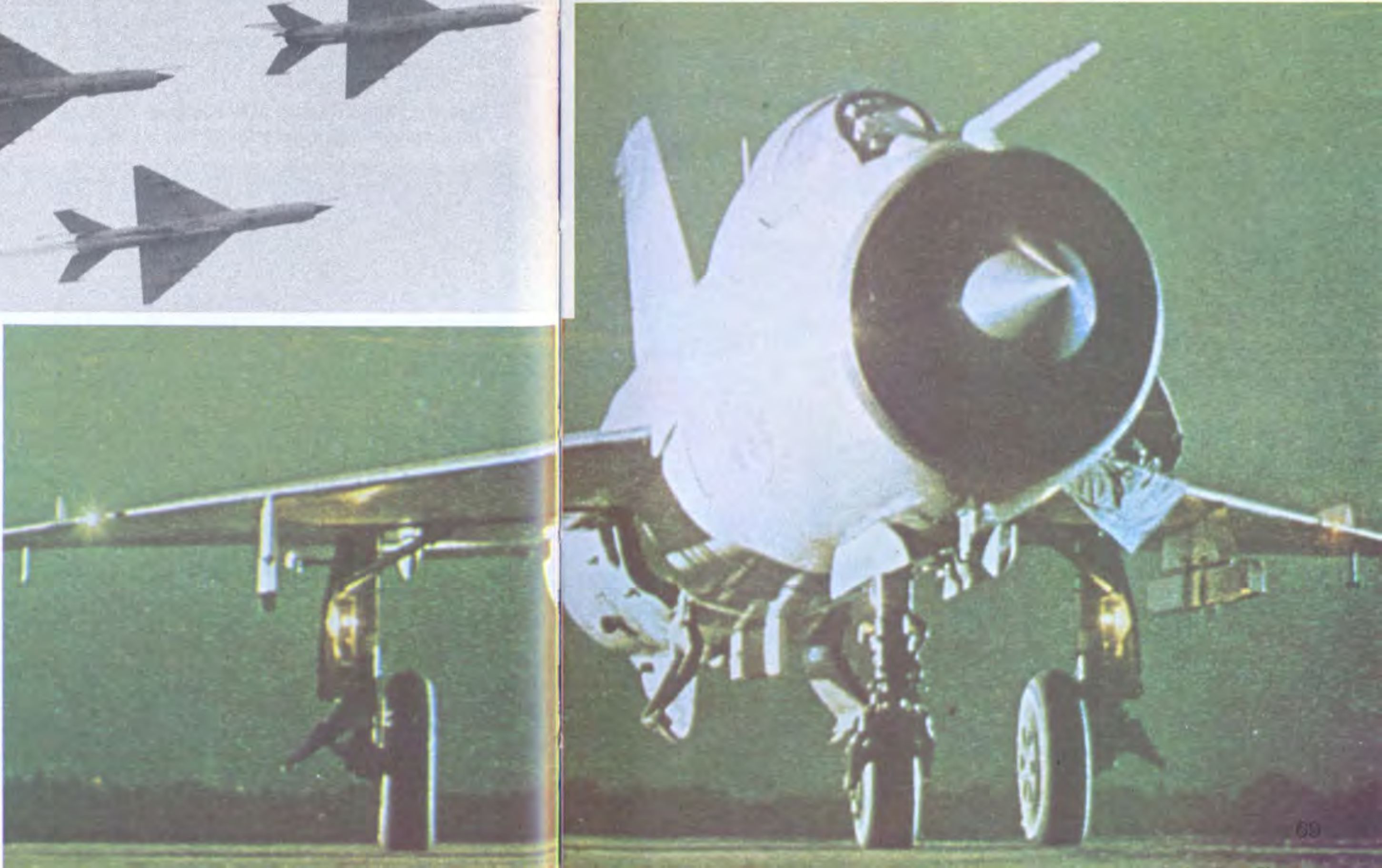
▶below the wing root to accommodate them in an enlarged bay) to give good flotation on unpaved surfaces, the instrument boom was moved to the top of the nose, and avionics were changed and upgraded with repositioned aerials. By 1961 PF and PFL variants had introduced a further broadened fin (twice the area of the original), a drag-chute compartment at the base of the rudder, small lips above and below the jet nozzle, and provision for ATO (assisted-takeoff) rockets. Most aircraft by late 1961 had seven fuel tanks for 627gal (2,850lit), and a conventional side-hinged canopy with fixed screen, and a proportion switched to blown flaps in an important modification called SPS which considerably reduced landing speed and the required field length (ATO rockets having similarly shortened the takeoff run). The SPS flaps became standard and by 1965 further sub-types (suffix PFS and PFM) introduced the F2S-300 series engine, a further increase in chord of the vertical tail, more powerful R2L radar and the new GP-9 belly gunpack incorporating the twin-barrel GSh-23 with about 200 rounds.

Curiously, the PFMA of 1967 had slightly reduced internal fuel (572gal/2,600lit) despite introducing a further-enlarged dorsal spine giving a straight top to the fuselage. Sub-types proliferated rapidly at this time, with over 20 different fits of EW (electronic warfare) equipment, reconnaissance cameras and flash cartridges, some aircraft being dedicated 21R and RF reconnaissance versions with pods which include SLAR. The KM-1 rocket-assisted seat, angle-of-attack sensor on the left of the nose, very large fin-top dielectric (mainly for VHF/UHF communications aerials) and internal GP-9 pack with only the barrels projecting progressively became standard, and often were retro-fitted to aircraft in service. Maximum external load rose to 3,307lb (1.5t), and in 1970 the 21MF entered service with the R-13 engine which offered more thrust for less weight, as well as suck-in auxiliary inlet doors under the leading edge with debris deflectors and a rear-view mirror above the windshield. An even larger dorsal fairing from canopy to drag-chute box characterized the SMT of about 1972, many of which have ECM pods on the wingtips. A fourth enlargement in the saddle fairing resulted in what is believed to be the current internal fuel capacity of 638gal (2,900lit) and introduction of a completely new engine and redesigned aircraft gave rise to the current production family, called 21bis, produced in numerous sub-variants. The R-25 engine is considerably more powerful and economical, and the avionics have also been further augmented by Jay Bird radar which is believed to be compatible with the AA-8 Aphid AAM.

Very large numbers of many MiG-21 variants remain in front-line service as the primary FA air-superiority fighter and most numerous tactical aircraft with all air arms. Total receipts for Soviet service probably exceed 8,000. Each of the main sub-series, with the four basic engines and different avionic, weapon and flap installations, also exists as a tandem dual MiG-21U trainer. A rough estimate for 1982 is 1,000 fighters, 350 EW/recon and 300 trainers.



Above: According to Tass these four MiG-21s were taking part in the West-81 exercise in September 1981. Apart from having smoke generators they appear to be standard MiG-21bis.



Right: This MiG-21 is a sharp contrast because it is of the old PF sub-type dating from 1960.

Mikoyan/Gurevich MiG-23

MiG-23B, BN, MF, U and other variants

Origin: The OKB named for A.I. Mikoyan and M.I. Guryevich.
Type: Multi-role fighter, attack and trainer.
Engine: (Early fighters and all trainers) one Tumanskii R-27 afterburning turbofan rated at 15,430/22,485lb (7/10.2t) thrust; (all current operational versions) one Tumanskii R-29B afterburning turbofan rated at 27,500lb (12,475kg) with max augmentation.
Dimensions: Span (16° sweep) 46ft 9in (14.25m), (72°) 26ft 9½in (8.17m); length (all known variants, excl probe) 55ft 1½in (16.8m), (with instrument probe) 59ft 10in (18.25m); height 14ft 4in (4.35m); wing area (gross, 16°) about 400sq ft (37.2m^2).
Weights: Empty (typical) 22,000lb (10t); internal fuel 10,300lb (4,672kg); loaded (air/air mission) about 32,000lb (14.5t); maximum (air/surface mission) about 41,000lb (18.5t).
Performance: Maximum speed (clean, SL) 840mph (1,352km/h, Mach 1.1), (clean, 36,000ft/11km), 1,520mph (2,443km/h, Mach 2.31) initial climb (clean) about 50,000ft (15km)/min; service ceiling (afterburner) 61,000ft (18.6km); takeoff/landing runs, each about 2,950ft (0.9km); combat radius (hi, internal fuel) 560 miles (900km); ferry range, 1,740 miles (2,800km).
Armament: (typical of combat versions, air/air mission) one GP-9 pack (GSh-23 gun with 200 rounds), two AA-8 Aphid AAMs on body pylons and two AA-7 Apex long-range AAMs on glove pylons; (air/ground mission) five pylons available for wide range of ordnance loads up to about 7,700lb (3.5t).
History: First flight (Ye-231) probably 1966; entry to service (MiG-23) 1970.

continued ▶

Below: Three-view of an early MiG-23MF 'Flogger-B' dating from 1976; many superficially similar sub-variants exist with other avionics.

Above: One of the six MiG-23F sub-variants ('Flogger-G') which made visits to Finland and to France in 1978. Avionics are fairly simple.

Right: A crack VVS fighter unit with laser-equipped MiG-23MFs.

▶**Development:** Designed to provide a very large increase in VVS tactical airpower, in both defence and offence, the MiG-23 family exactly followed the UK/NASA swing-wing geometry with pivots at the leading edges of a small fixed portion of centre section called a glove. This configuration is more efficient than the mid-semi-span pivot, with a larged fixed centre section, adopted for such aircraft as the Su-22 and Tu-22M. The Ye231 prototype was convincingly demonstrated in July 1967 but the MiG-23 production aircraft was the result of considerable further development as well as the availability of a more modern engine (the first augmented turbofan in production in the Soviet Union). Predictably, the basic aircraft has been produced in numerous versions, most of them known only by their Western code-names in the 'Flogger' series. In the late 1970s the production rate climbed to a formidable 600 per year (much greater than that for all NATO tactical fighter aircraft combined), and by 1982 the VVS alone–not including other WP air forces and many export customers–was estimated to have received 2,500 aircraft of the MiG-23 and -27 family.

The Ye-231 is believed to have been powered by an AL-21 series engine, and a development unit, possibly of regimental strength, of this type entered FA service in 1970-71. The regular production MiG-23, with the much shorter rear fuselage made possible by the Tumanskii turbofan engine, did not become available until 1973-74. A significant change in the production machine was the addition of extremely large dogtooth discontinuities on the swing-wings at the inboard end of extended outer portions with leading-edge flaps. To preserve centre of gravity position the gloves were shortened, the pivoted wings being moved slightly forward. The trailing-edge flaps were improved, in three single-slotted sections (not blown) covering the entire span and preceded by inner/outer spoilers used for roll control and as lift-dumpers after landing. Four airbrakes are fitted around the rear fuselage. The powered tailerons provide primary all-speed roll control, and a large ventral fin is extended whenever the landing gears are retracted. The main gears have wide-track legs pivoted to the fuselage and almost horizontal when bearing the aircraft's weight; the low-pressure main wheels carry bay doors doubling as mudguards while ad hoc mudguards are fitted to the steerable twin-wheel nose unit. The engine is fed by narrow rectangular air ducts with either a fixed plain inlet or, in most MiG-23 variants, a variable inlet very like that of the F-4 Phantom with an inner ramp, boundary-layer extraction and power-driven inner walls to adjust the shock at Mach▶

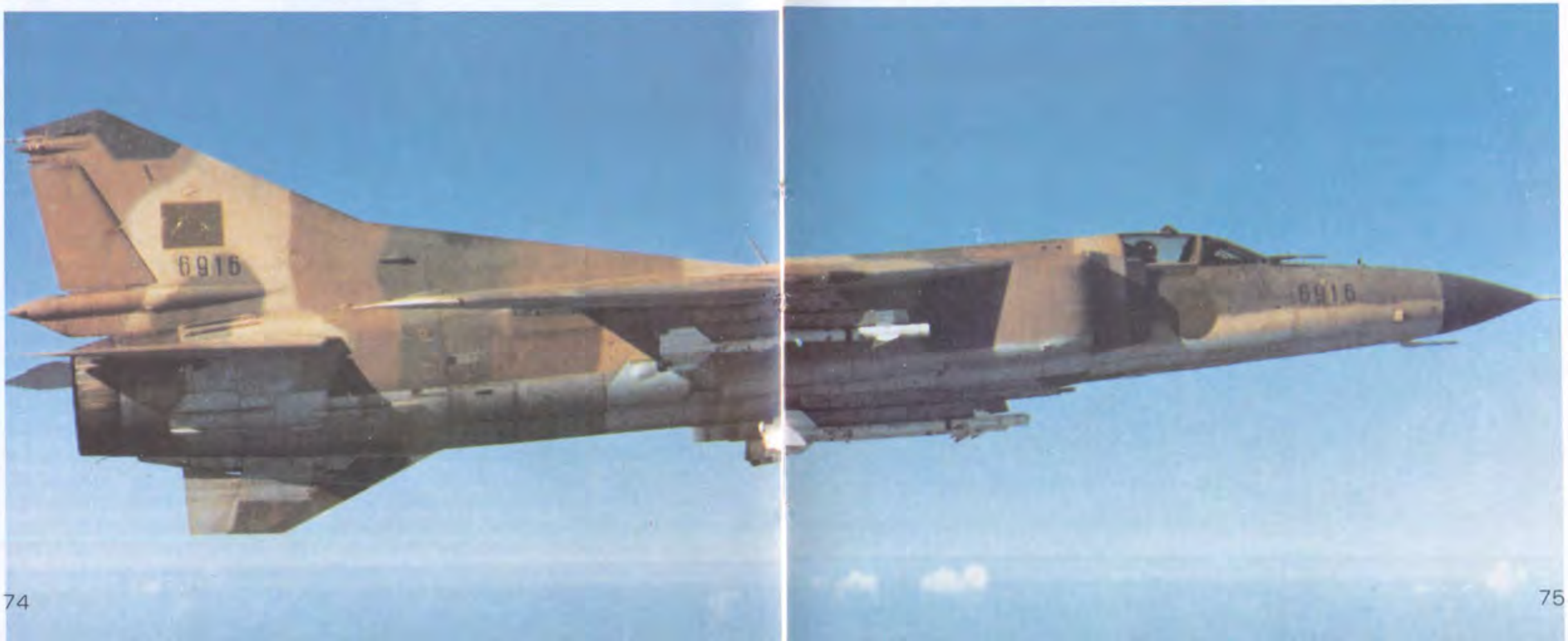
▶numbers over about 0.9. The canopy, hinged at the rear, is aligned with the top of the fuselage, and rear view depends on the internal mirror.

The same basic aircraft was put into production in a growing number of multi-role fighter vrsions, as a tandem dual trainer and also in a dedicated ground-attack variant described separately as the MiG-27. The first major production series was the MiG-23MF, in various sub-types called 'Flogger-B' by NATO. This usually carries the J-band radar called 'High Lark', with a large nose radome carrying a downward-sloping pitot boom at its tip; yaw and angle of attack sensors are on the forward fuselage together with doppler radar, IFF, ILS and (primarily for surface-attack weapons delivery) a laser ranger and marked-target seeker. Standard Sirena 3 radar warning is fitted, together with comprehensive ECM threat-analysis and jamming (though for penetrating high-threat areas jammer/flare/chaff dispensers must occupy at least one pylon). It would seem logical that for dedicated air-combat employment an IR receiver would be more useful than a laser ranger, especially as until about 1977 the AAM available was the AA-2-2 Advanced Atoll with significant need for IR assistance in its IR version. The radar was likened by the USA to that of the F-4J and described as the first in the nation to have a significant capability against low-level targets; later the 23MF demonstrated an impressive ability to engage targets at far above its own altitude using the large AA-7 missile. The trainer version has a substantially redesigned forward fuselage with a slimmer nose housing R2L-series radar, two stepped cockpits with separate hinged canopies, a periscope for the instructor at the rear and a sloping sill extending to the front of the windscreen, and a larger dorsal spine fairing covering the much larger air-conditioning system. Internal fuel is naturally reduced, and the engine is the R-27.

In 1978 a variant of the MF, called 'Flogger-G', visited Finland and France. At first these were regarded merely as simplified short-series aircraft to make goodwill foreign visits without compromising the security of the advanced avionics, but later this variant was recognised as a regular type in FA regiments. It has a smaller dorsal fin and has been seen with a new undernose sensor pod. Dedicated attack members of the MiG-23 family are styled MiG-23BN and exist in many variants, some export models with simpler avionics. One, called 'Flogger-H', is virtually a MiG-27 with powerplant installation of the 23. Further models, including a carrier-based variant for the AVMF, were expected in 1982.

Above: This MiG-23MF is assigned to an IA-PVO air defence unit. The blanking caps on inlets and laser have the individual aircraft number.

Below: A very recent 'Flogger-E' (true designation unknown) of the Libyan Arab AF, with 'Advanced Atoll' AAMs photographed in 1981.



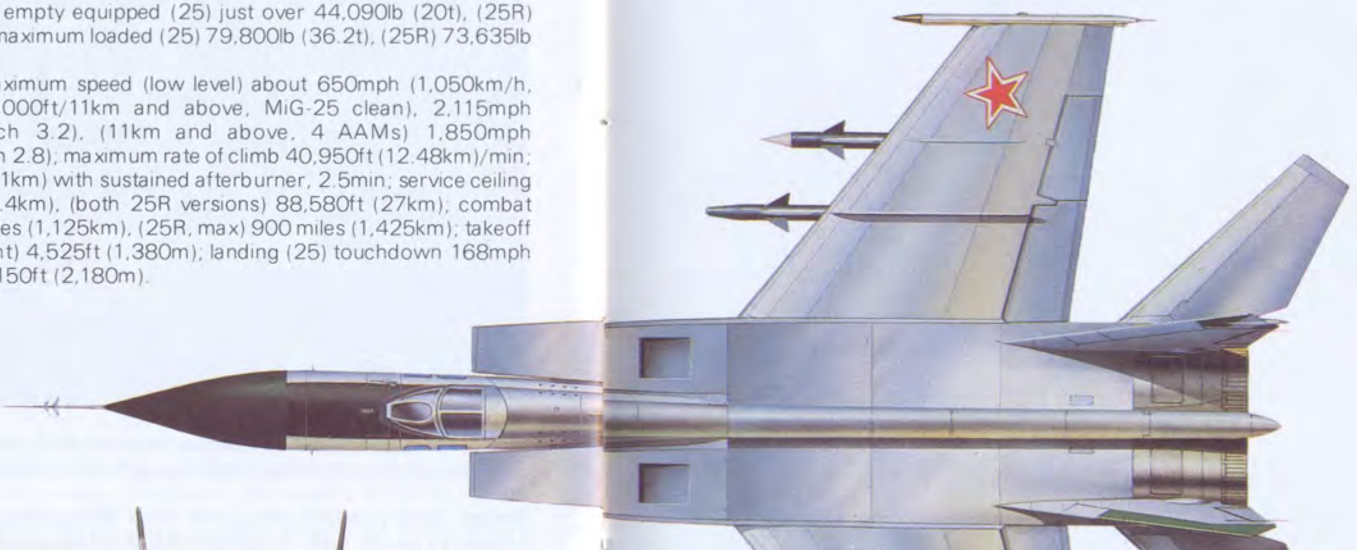
Mikoyan/Gurevich MiG-25

MiG-25, 25R, 25U and later variant(s)

Origin: The OKB named for A.I. Mikoyan and M. I. Guryevich.
Type: (25) high-altitude interceptor, (R) strategic reconnaissance, (U) trainer.
Engines: Two Tumanskii R-31 afterburning turbojets each rated at 16,755/24,250lb (7.6/11t) thrust.
Dimensions: Span 45ft 9in (13.95m), (25R) 44ft 0in (13.40m); length (all known variants), (overall), 78ft 1¾in (23.82m), (fuselage only) 63ft 7¾in (19.40m); height 20ft 0¼in (6.10m); wing area, gross, 662sq ft ($56.83m^2$), (25R) slightly less.
Weights: (typical) empty equipped (25) just over 44,090lb (20t), (25R) 43,200lb (19.6t); maximum loaded (25) 79,800lb (36.2t), (25R) 73,635lb (33.4t).
Performance: Maximum speed (low level) about 650mph (1,050km/h, Mach 0.85), (36,000ft/11km and above, MiG-25 clean), 2,115mph (3,400km/h, Mach 3.2), (11km and above, 4 AAMs) 1,850mph (2,978km/h), Mach 2.8); maximum rate of climb 40,950ft (12.48km)/min; time to 36,090ft (11km) with sustained afterburner, 2.5min; service ceiling (25) 80,000ft (24.4km), (both 25R versions) 88,580ft (27km); combat radius (25) 700 miles (1,125km), (25R, max) 900 miles (1,425km); takeoff run (25, max weight) 4,525ft (1,380m); landing (25) touchdown 168mph (270km/h), run 7,150ft (2,180m).
Armament: (25) four AAMs on separate wing pylons, usually two AA-6 Acrid IR plus two AA-6 Acrid radar; alternatively two AA-7 Apex and two AA-8 Aphid or four AA-7 Apex; (R) none; (U) none in examples seen.
History: First flight (Ye-26) probably 1964 (series 25 and 25R) probably both 1969; service delivery, probably 1970.

Development: Backed by a very large aerodynamic, structural and propulsion research programme, the MiG-25 family was initiated in the late 1950s to provide an interceptor to shoot down the threatened USAF B-70 (RS-70) Mach 3 bomber and reconnaissance aircraft. When the latter was ▶

Below: A MiG-25 'Foxbat-A' of the IA-PVO, armed with two radar 'AA-6 Acrid) missiles (outboard) and two of the IR heat-seeking type.



▶cancelled the MiG-25 was continued, partly for the prestige of record-breaking but also because of its great potential as a high-altitude interceptor and uninterceptable reconnaissance platform. It forms a close parallel with the American YF-12A and SR-71 though on a slightly less-advanced scale. Like the Lockheed machines its design had to be optimised for the maximum-speed cruise regime, and the MiG-25 interceptor has no capability whatever at close ranges or in normal air combat. Like the F-14 it has stand-off kill capability, though this does not equal that of the F-14 because of the shorter range of the radar.

Because of its early design the MiG-25 radar, called 'Fox Fire' by NATO, is a very bulky set using mainly vacuum tubes (thermionic valves) like the AWG-10 of early F-4 Phantoms. Operating in I-band, the very high peak▶

Left: Though the basic design of the MiG-25 holds few secrets, following detailed analysis of the example flown to Japan, continued improvement of the type keeps Western intelligence officers on their toes. They were particularly glad when aircraft of the US Navy obtained superb close photographs of an example serving with the Libyan Arab Republic AF in August 1981. This aircraft was armed with just two of the giant 'AA-6 Acrid' missiles, which had not previously been photographed from such close quarters. That on the right wing is a radar homing model.

Below: This photograph of two MiG-25R reconnaissance aircraft, released in January 1981, is particularly clear and the first to show details of the two sub-variants of this family. The aircraft on the right is a 'Foxbat-B' with cameras and three radars including a small SLAR (side-looking aircraft radar). The 'Foxbat-D' on the left has no cameras and different radars, including—it is believed—a much larger SLAR nearer the cockpit. Both aircraft, seen about to take off from an airbase in the Trans-Baikal Military District in eastern Siberia, are painted overall 'air-superiority grey'.

▶power of 600 kW is used mainly to burn through enemy jamming rather than to increase range, so the estimated range does not exceed 53 miles (85km). Likewise the AAM designed for the MiG-25, the AA-6 Acrid, has gigantic size mainly in order to guarantee destruction of even the largest target aircraft with a single near miss. Normally two IR-homing missiles and two semi-active CW-homing radar missiles are carried. It has been claimed that the original radar/AAM combination did not have look-down/shoot-down capability, and it certainly could not handle multiple targets, but since 1976 completely new avionics have been fiatted (details not yet known) with solid-state circuits, increased range and a large digital processor.

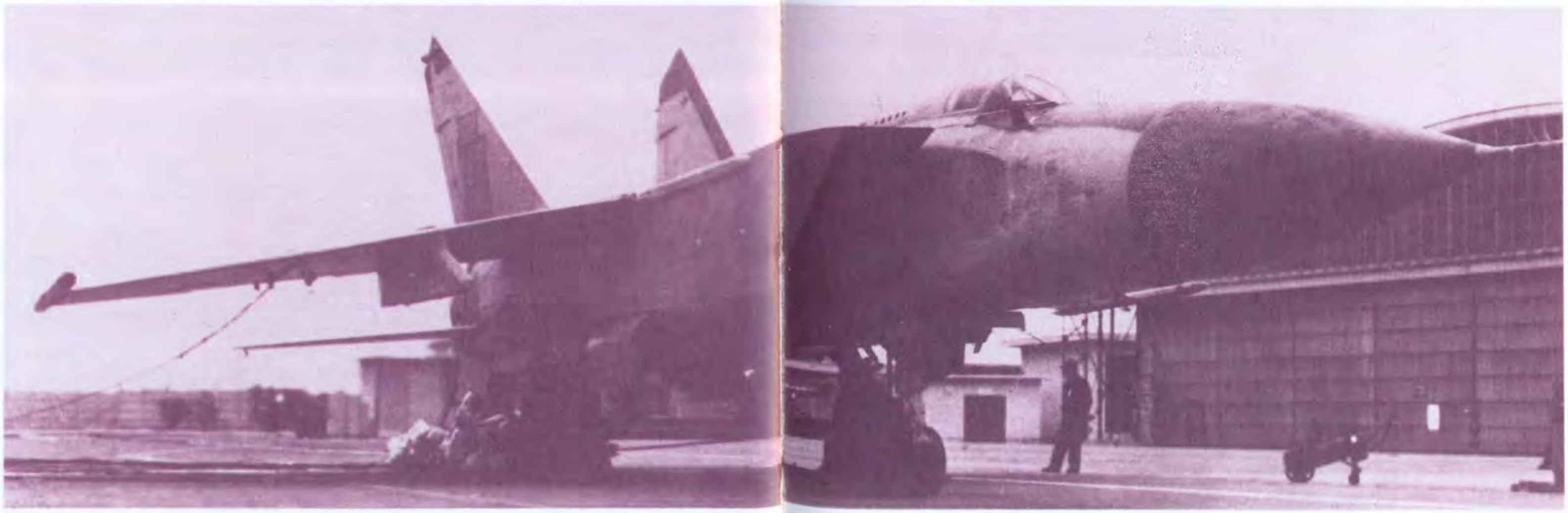
The basic aircraft is in many respects unique. The wing is unswept, but tapered on the leading edge and set at 4° anhedral, and with thickness/chord ratio of well under 4 per cent. The slim oval fuselage merges into giant flanking air ducts with enormous sloping inlets broadly similar to those of Concorde or Tu-144 with powered doors above and below, large bleed outlets, variable roof profile and (not a feature of the SSTs) variable transverse control shutters and high-rate water/alcohol sprays. About 3,850gal (17,500lit) of regular kerosene fuel is housed in nine welded-steel tanks in the fuselage and a large integral tank forming an inner box of each wing. The basic airframe material is steel, with leading edges of titanium (except for the left inclined fin whose leading edge is a dielectric aerial). The only movable surfaces comprise powered ailerons (well inboard from the tips), powered slab tailplanes, twin powered rudders and plain flaps (apparently not blown). Twin ventral fins incorporate tail bumpers, with an airbrake between them, and twin braking parachutes can be streamed from the rear of the dorsal spine. The landing gears have high-pressure tyres, single on the forward-retracting main legs and twin on the steerable nose unit, and there has been no attempt to fit the MiG-25 to anything but a long paved runway. Provision for internal ECM and ECCM systems is typically comprehensive, and CW illuminating power for the radar-type AAMs is emitted from the nose of the long anti-flutter bodies on the wingtips.

The MiG-25R reconnaissance version has a different wing with constant leading-edge taper and shorter span. It is used in two main variants (so far identified) called 'Foxbat-B' and 'Foxbat-D'. The former has a nose containing five vertical/oblique cameras ahead of the cockpit, a SLAR (side-looking airborne radar) on the right side and small ground-mapping and doppler radars in the underside, ahead of the cameras. A small forward-looking radar, said to be Jay Bird (also used on export MiG-23s), is in the nose tip. The D-variant has a much larger SLAR and no cameras. The MiG-▶

Above: Even the MiG-25U trainer retains flat bullet-proof windshields.

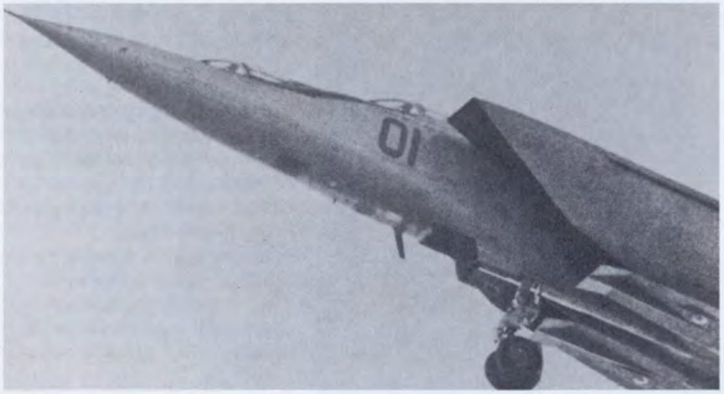
Left: The impressive size of the nozzles of the R-31 engines is characteristic of turbojets designed to reach peak efficiency at high flight Mach numbers, the maximum area of the variable nozzles being greater than that of the variable inlets.

Below: MiG-25 is first and largest of new breed of fighters with twin vertical tail surfaces.



▶25U trainer has a second (pupil) cockpit added lower down in the nose in place of radar and other sensors. All trainers so far seen have the wing of the fighter but no armament or sensors (apart from Jay Bird radar in the tip of the nose) and because of extra drag are rather slower than the single-seat versions.

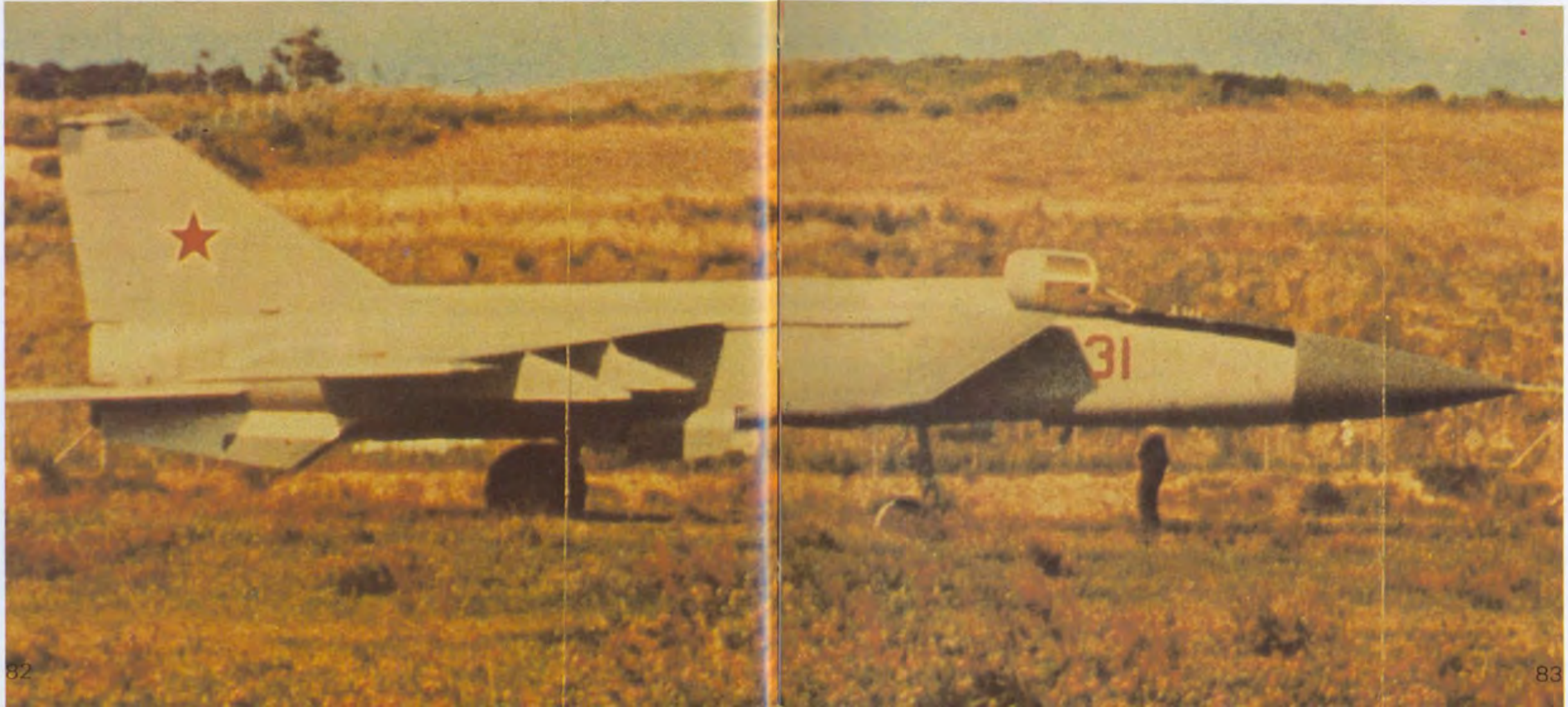
About 400 MiG-25s of all versions had been delivered by 1976, divided roughly equally between MiG-25Rs of the FA and MiG-25 interceptors of the APVO (both services use the trainer). Since that time it is reasonable to suppose that the advanced version described by a defecting MiG-25 pilot, Lt V. Belyenko, has gone into service. This (like record-breaking Ye-266M prototypes) has engines uprated to 30,864lb (14t) thrust, a strengthened airframe, pylons for six AAMs, a completely new fire-control system able to handle low-level (look-down) targets and engage at least four simultaneously, and new missiles including the AA-9 (previously AA-X-9). But any aircraft based on the MiG-25 would reamin an essentially 'straight line' interceptor, able to kill only with AAMs fired from a distance. The reported installation of a gun in the 'Super MiG-25' is hard to comprehend.



Above: A frame from an early propaganda film showing the first MiG-25 interceptors. The trails are caused by venting fuel.

Left: The nose of the MiG-25U contains tandem cockpits but almost no sensors. The lower inlet flaps are in the low-speed position.

Below: Lt Belyenko's interceptor photographed at Hakodate shortly after its surprise arrival in 1976. Pity he brought no missiles!



Mikoyan/Gurevich MiG-27

MiG-27

Origin: The OKB named for A.I. Mikoyan and M.I. Guryevich.
Type: Ground-attack aircraft.
Engine: One Tumanskii R-29 series augmented turbofan with maximum afterburning thrust of 25,353lb (11.5t).
Dimensions: Span (16° sweep) 46ft 9in (14.25m), (72°) 26ft 9½in (8.17m); length (excl probe) about 53ft 5in (16.28m), (with probe) 55ft 6in (16.9m); height 14ft 4in (4.35m); wing area (gross, 16°) about 400sq ft ($37.2m^2$).
Weights: Empty, about 22,000lb (10t); maximum with no external weapons, 34,170lb (15.5t); maximum takeoff, 44,310lb (20.1t).
Performance: Maximum speed (SL) clean about Mach 1.1, with external weapons 723mph (1,163km/h, Mach 0.95); maximum speed at high altitude (clean) about 1,050mph (1,700km/h, Mach 1.6); service ceiling, about 50,000ft (15.24km); takeoff to 50ft (15m) at clean gross weight, 2,625ft (800m); combat radius (all lo, centreline tank, four FAB-500 bombs and two AAMs), 240 miles (386km); ferry range (three tanks) 1,550 miles (2,500km).

Armament: one 23mm multi-barrel gun; external weapon load of up to 7,716lb (3.5t) carried on maximum of seven pylons, including AS-7 'Kerry' ASM, various nuclear or conventional bombs, with aA-2-2 AAMs for protection.
History: First flight (Ye-23 series attack prototype) possibily 1970; service delivery (27) not later than 1974. ▶

Below: Three-view of an early MiG-27 of 'Flogger-D' type with fixed-geometry inlets and the multi-barrel gun on the ventral centreline.

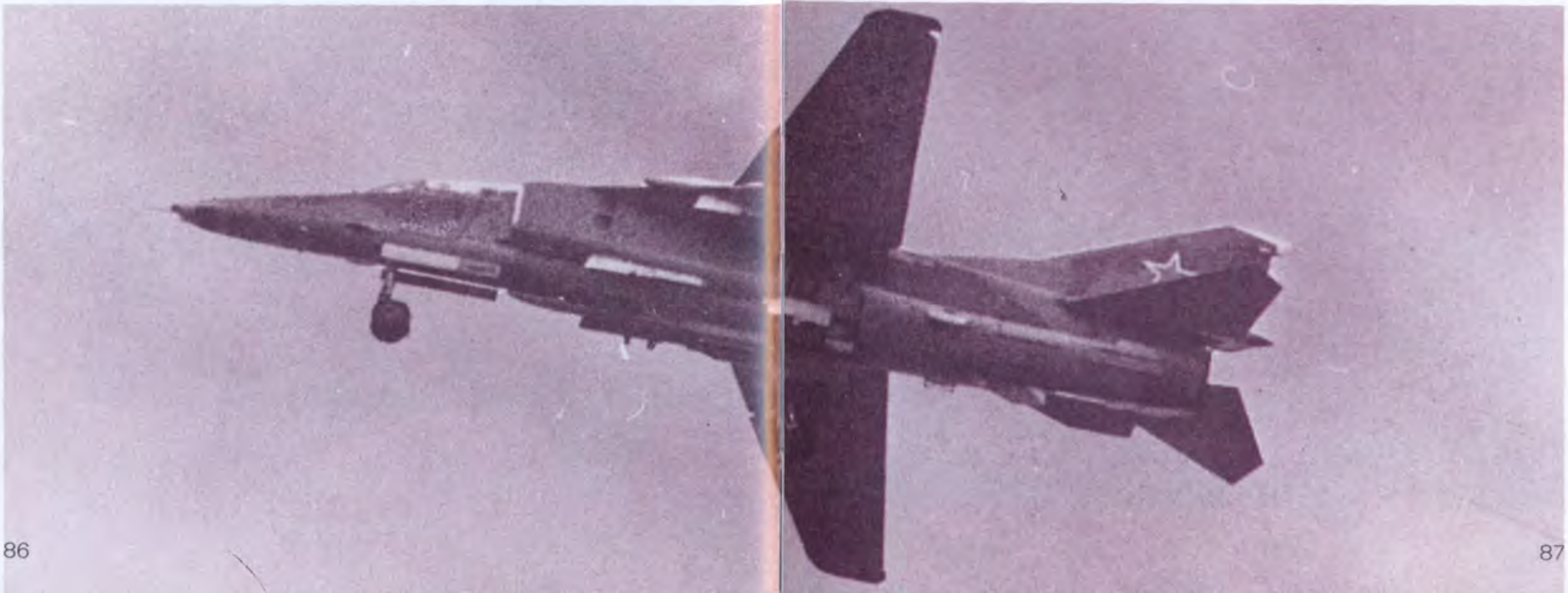
▶**Development:** Using the same airframe as the MiG-23, this dedicated attack aircraft has a simplified propulsion system making no attempt to fly fast at high altitude. It also has a new nose with a down-sloping broad profile–resulting in the pilot nickname 'Ducknose'–not only giving excellent forward view but also accommodating every deisred avionic item for the surface attack mission, in place of a radar. Even the cockpit is repositioned at a higher level with a deeper hinged hood and windshield to give the best possible pilot view over the terrain ahead (the resulting extra drag is not important). A further change is the fitting of tyres of greater size and reduced inflation pressure for operations from rough unpaved airstrips. The engine is basically an R-29 but has a smaller afterburner with simple variable nozzle matched to maximum thrust at takeoff and in low-level missions (the nozzle is noticeably shorter than that of the MiG-23 family).

There is still uncertainty about precisely what sensors and EW equipment is fitted to the standard MiG-27. Certainly the oblique forward 'chisel' window covers a laser ranger and marked-target seeker. The small radome at the tip of the nose is for air/air ranging in conjunction with the gun. Under the nose is a doppler navigation radar and further aft on each side are small blisters over CW target-illuminating radars. Familiar aerials on the nose include the matched trio for SRO-2M 'Odd Rods' IFF and the forward-pointing 'Swift Rod' ILS, matched by a similar probe aerial on the fin facing aft. Sirena 3 radar homing and warning uses aerials on the leading edges and tail in the usual way, while forward-pointing pods on the fixed wing glove leading edges are thought to be an ASM guidance transmitter (left) and an active ECM jammer transmitter (right), though both beliefs are as yet unconfirmed. Certainly the MiG-27 is designed to carry all available tactical missiles, fuel/air explosives, cluster munitions and laser-guided 'smart' bombs. The six-barrel 'Gatling' gun is a new weapon, not by 1982 identified on other Soviet aircraft.

Until late 1981 only the original MiG-27 had been identified in FA regiments, accounting for some 1,000 aircraft of which about 750 are in the active inventory. Training is done on the MiG-23U, some variants of which have MiG-27 type sensors. The closely related 'Flogger-F' and 'Flogger-H' are members of the MiG-23 family. The latest MiG-27 is called 'Flogger-J' by the US Department of Defense, but details had not been made public as this book went to press.

Above: The sensor-packed nose is broad and flat, for good pilot view; its shape has resulted in the nickname of "Ducknose".

Below: One of the first MiG-27 'Flogger-D' attack aircraft to be photographed in East Germany in the mid-1970s. Note cutback nozzle.



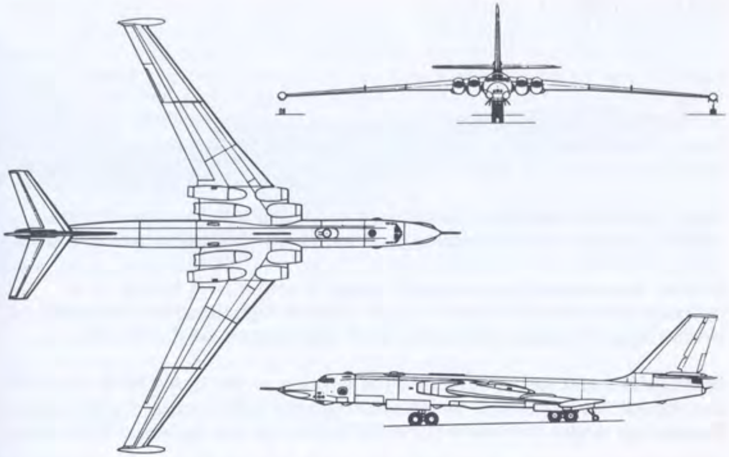
Myasishchev M-4

M-4 (sub-type unknown)

Origin: The OKB of V.M. Myasishchev.
Type: (1) bomber, (2) tanker.
Engines: Four 28,660lb (13t) thrust Soloviev D-15 by-pass turbojets.
Dimensions: Span 172ft 2in (52.5m); length 162ft 0in (49.38m), (with FR probe) about 170ft 0in (51.8m); height 46ft 0in (14.24m); wing area 3,400sq ft (320m²).
Weights: Empty (bomber or tanker) about 185,000lb (83.9t); normal loaded 375,000lb (170t); max overload 462,960lb (210t).
Performance: Maximum speed at 36,100ft (11km), 625mph (1,005km/h, Mach 0.945); typical cruising speed (same height or above) 560mph (900km/h); service ceiling (normal weight) 52,000ft (15.85km); max operating radius (unrefuelled) 3,480 miles (5,600km); range with 22,000lb/10t bombload, 4,970 miles (8,000km); ultimate range with max overload fuel and no weapons, about 11,000 miles (18,000km).
Armament: (tanker) none, or twin NR-23 in tail turret; (bomber) six NR-23 in tail and forward dorsal and ventral barbettes, internal weapon load up to 33,070lb (15t), believed all free-fall.
History: First flight (M-4 prototype) 1953; service delivery ('Bison-A') 1956.

Development: V.M. Myasishchev had been chief designer on many important 'Tupolev' aircraft before in 1951 he took on the task of creating a jet bomber to fly strategic missions. The task was on Stalin's direct order, but with contemporary technology was impossible except with an aircraft of unrealistically gigantic size. Myasishchyev chose to build a practical (but still very challenging) machine, even though it did not fully meet the requirement for range. Stalin's death in 1953 avoided personal recriminations, and the original model, popularly called the Molot (hammer) and code-named 'Bison-A' by NATO, went into service with the ADD (now DA) in 1956. This version was powered by four 19,180lb (8.7t) thrust Mikulin AM-3 turbojets buried in the roots of the extremely impressive long-span wing. The large circular-section fuselage incorporated a pressurized crew compartment at the front for five, with a sixth manning the tail sighting station controlling up to three of the five turrets each armed with twin 23mm cannon. The large central bomb bay was covered by twin doors and filled the whole cross section under the wing. The landing gear chosen was of the bicycle type as used previously on the B-47, but because of the M-4's great weight the front and rear main units had to be large four-wheel bogies, supplemented by single outrigger tip-protection gears retracting into streamlined pods on the wingtips (these pods emphasize the sharp washout in wing incidence and appear to have a pronounced nose-down attitude).

Though not far short of an early B-52 in weight, fuel capacity and general performance, the M-4 could not meet the full ADD mission radius and probably only about 200 were built. Development naturally continued, and mission radius was dramatically extended from 1957 by fitting a flight-refuelling probe and the newly developed D-15 engine. The latter enabled maximum weight to be greatly increased, dimensions being slightly enlarged ▶



Above: Three-view of M-4 of so-called 'Bison-C' sub-type.

Below: What appears to be a six-man crew walk away from a 'Bison-C' maritime reconnaissance aircraft of the AVMF. The US DoD believes this naval variant has now been retired from service.

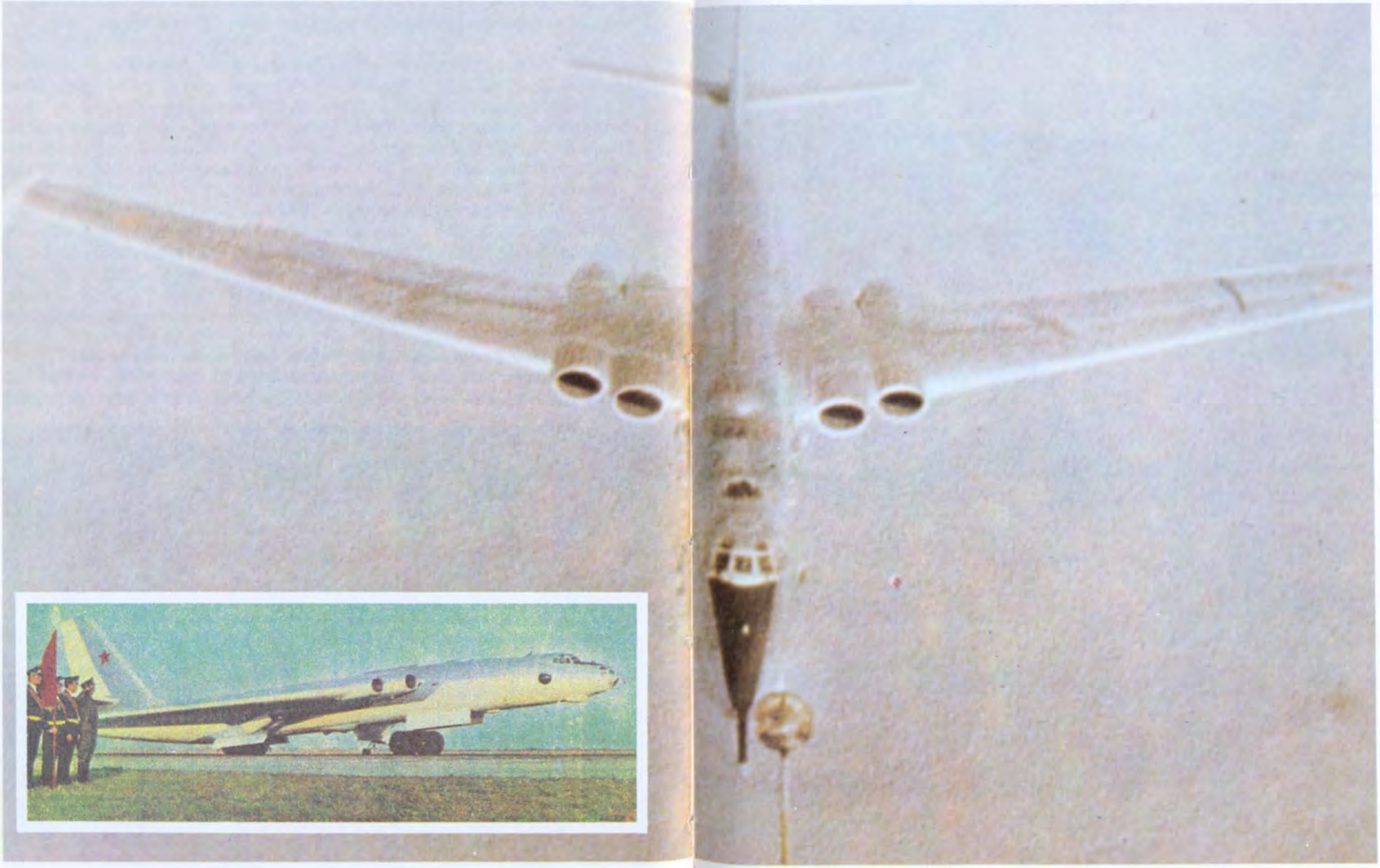
▶and the rear upper and lower gun barbettes being removed. The glazed nose was replaced by either of two very large mapping radars, the larger radar being fitted to the AVMF model called 'Bison-C' and used as a multi-sensor Elint/EW/recon platform with an attack and missile-guidance capability. All these have been retired, but about 75 M-4s remain in the front-line inventory of the DA, some 45 as heavy bombers, with probes and the capability of serving as tankers if necessary, and the other 30 as dedicated tankers pending availability of the triple-point Il-76. An idea of the capability of the M-

Right: One of the oldest variants, the 'Bison—B' was the original AVMF oceanic reconnaissance platform, with two radars and cameras.

Below: An unusual photograph taken from an M-4 tanker of a recipient aircraft of 'Bison-C' type. The straightforward hosereel and drogue is used, unlike the tip-to-tip scheme of the Tu-16.

Inset: The most important current version is the basic M-4 free-fall bomber of the DA, one of which is being greeted by a guard of honour. Some may retain the lower-thrust Mikulin AM-3 engines of 1954-55.

4 is provided by the world record speed of 1,028km/h (638mph) round a 1,000km (62(621-mile) circuit with a simulated bombload of 27t (59,525lb) and the lifting of a load of 55t (121,275lb) to a height of 43,036ft (12,121m). Though ostensibly the 75 survivors are still 'Bison-A's' they have for almost 20 years been fitted with D-15 engines and the other major modifications listed.



Sukhoi Su-7

Su-7, 7B, 7U, 7BK, BKL, BM, BMK, UM and UMK

Origin: The OKB of Pavel O. Sukhoi.
Type: Ground-attack fighter.
Engine: One Lyul'ka afterburning turbojet, (7, 7B) 19,841lb (9t) AL-7F (later variants) AL-7F-1 rated at 15,432/22,046lb (7t/10t).
Dimensions: Span 29ft 3½in (8.93m); length (incl probe) 57ft 0in (17.37m), (7U) 58ft 8½in (17.7m); height 15ft 5in (4.7m); wing area 297sq ft (27.6m²).
Weights: (BMK, typical) empty 19,000lb (8,620kg); normal loaded 26,455lb (12t); maximum 29,750lb (13.5t).
Performance: Maximum speed (36,000ft/11km), clean 1,055mph (1,700km/h), Mach 1.6), (four loaded pylons) 788mph (1,270km/h, Mach 1.2); (SL) max afterburner 837mph (1,345km/h, Mach 1.1, (dry) 530mph (850km/h); max initial climb (afterburner, clean) 29,000ft (8,840m)/min; service ceiling 49,700ft (15.15km); combat radius (with tanks, hi-lo-hi) 200/300 miles (322/480km); range (two tanks) 900 miles (1,450km).
Armament: Two NR-30 guns each with 70 rounds; two side-by-side fuselage pylons and (7, B) two, (all later variants) four, (many BMK) six, underwing pylons, normal load being two fuselage tanks (total 2,100lb/952kg) and up to 2,205lb (1t) ordnance on wings.
History: First flight (S-1) 1955, (production Su-7) late 1958. ▶

Below: Good feature of the Su-7BMK is excellent handling; a basic shortcoming is inability to carry bombs and fuel at the same time!

►**Development:** The reconstituted Sukhoi OKB in early 1954 put all its design engineers on to two major VVS projects, one with a tailed delta and the other an acutely swept (62° leading edge) wing of quite high aspect ratio. The latter prototype, the S-1, is believed to have been the first aircraft in the Soviet Union with a powered 'slab' tailplane, and may have been the first with a nose inlet with a sliding centrebody to adjust the geometry to the flight Mach number. The engine was the large AL-7 turbojet by Arkhip Lyul'ka, establishing a partnership which survives to the present day. This engine and afterburner completely filled the rear half of the large tubular fuselage, the pressurized cockpit with sliding canopy being between the inlet ducts and above the forward-retracting nosewheel. The very powerful guns in the production Su-7 were installed in the wing roots, with steel skin over the adjacent fuselage. All units of the landing gear have low-pressure tyres on levered-suspension legs for use from rough airstrips, takeoff being assisted by two large rockets clipped under the rear fuselage and landing shortened by four petal airbrakes (backing up large track-mounted plain flaps) and a braking-parachute system which in the BM and BMK comprises two canopies streamed from a fairing at the base of the rudder.

After prolonged development with S-1, S-2 and subsequent prototypes the Su-7 was cleared for production in 1958 and the Su-7B entered FA service the following year. At least 1,000 of this model were built, including the tandem dual Su-7U trainer with two clamshell canopies and a dorsal spine. By 1961 the Su-7BKL had introduced two duct fairings along the top of the fuselage and a pitot boom offset to the right. The BM introduced an uprated engine, twin braking parachutes and larger gun blast panels, and the major production variant, the BMK, was adapted to rough airfields with large low-pressure tyres and ATO rockets. Together with the Su-7UMK two-seater about 3,000 BMK have been built, and well over 1,700 exported to 14 air forces. All versions appear to have retained excellent handling at all speeds, but to suffer from primitive avionics and extremely poor ability to

Above: The NR-30 packs an exceptional punch; each has 70 rounds.

carry fuel and weapons at the same time. About 660 remain in use in Soviet regiments but none are in areas regarded as sensitive, where the swing-wing derivatives have supplanted the Su-7. No other aircraft better illustrates the Soviet policy of progressive improvement than this very basic attack platform which in totally transformed versions (see Su-17) remains in production.

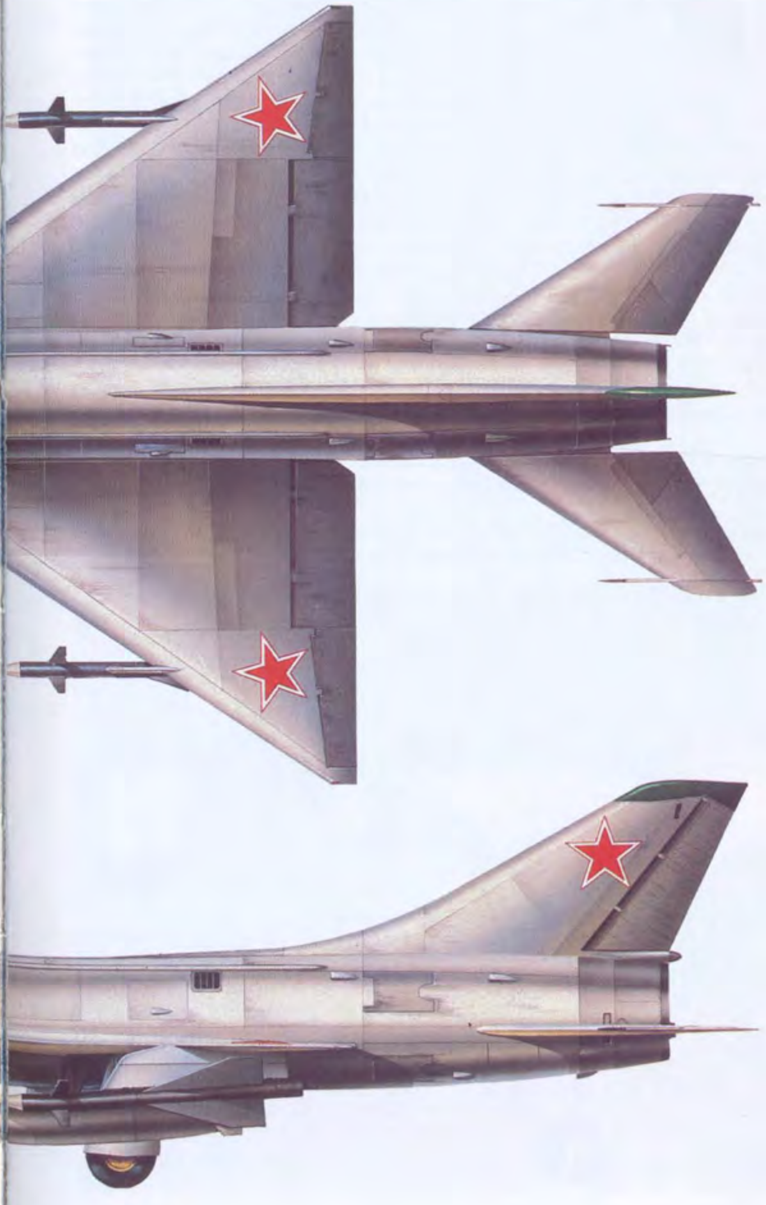
Below: A posed photograph of Su-7BKL attack aircraft with their pilots; this was one of the first production versions after the -7B.

Sukhoi Su-11

Su-9/-11

Origin: The OKB of Pavel O. Sukhoi.
Type: All-weather interceptor.
Engine: (9) one 19,840lb (9t) Lyul'ka AL-7F afterburning turbojet, (11) one 22,046lb (10t) AL-7F-1.
Dimensions: Span 27ft 8in (8.43m); length (incl probe) (9) about 57ft 0in (17.37m), (11) 60ft 0in (18.29m); height 16ft 0in (4.88m); wing area about 280sq ft (26m²).
Weights: Empty (9) about 19,000lb (8,620kg), (11) about 20,000lb (9t); loaded (9) about 27,000lb (12.25t), (11) 30,000lb (13.6t).
Performance: Maximum speed (both, clean, 36,000ft/11km) about 1,320mph (2,125km/h, Mach 2), (two tanks and AAMs), (Su-9) about 750mph (1,200km/h, Mach 1.14), (11) 840mph (1,350km/h, Mach 1.27); max initial climb (both) about 27,000ft (8.2km)/min; service ceiling, from about 55,000ft (16.76km) for Su-9 with AAMs to 62,000ft (18.9km) for Su-11 clean); range (both, high-altitude, two tanks and AAMs) about 700 miles (1,125km).
Armament: (9) four K-5M ('AA-1 Alkali') AAMs; (9U) usually not fitted; (11) two 'AA-3 Anab' AAMs (normally one IR homing, one SAR homing).
History: First flight (T-3) probably late 1955, (T-40) probably 1958, (production Su-9) probably 1959, (Su-11) probably 1961. ▶

Below: This three-view of the Su-11 shows the twin body drop tanks, with 2,100-lb (953kg) of fuel, and twin 'AA-3 Anab' missiles. Both are radar guided; in practice one is usually of the IR-homing model.



Development: The originator of all the numerous subsequent Sukhoi tailed-delta aircraft was the T-3 prototype, which was one of those publicly flown at the 1956 Aviation Day display. It had a conical fairing suitable for a radar at the top of the otherwise circular nose inlet, and this precluded the fitting of a variable-geometry inlet. Sukhoi's OKB spent the next two years studying inlets for radar-equipped interceptors, the T-7 (also known as PT-7) having a curious upper/lower lip to an essentially rectangular two-dimensional inlet in which the angles and throuat area were varied by pivoting these lips despite the fact the upper lip contained a radar. The P-1 two-seater had lateral inlets with small centrebodies, but with the PT-8 the bureau at last managed to fit a large Uragan 5B radar into the translating three-shock centrebody of a most efficient variable nose inlet, considerably better than the fixed inlet of the contemporary Lightning. Long before this, however, a design had to be committed to production to meet the urgent PVO need for a good supersonic interceptor, and this was the Su-9, an offshoot of the T-40 series with a simple short inlet and small centrebody housing the old R1L radar matched to the primitive K-5M missile as used on the existing MiG-19PM which the Sukhoi delta began to replace in 1959. The 57° wing housed nearly all the 7,800lb (3,540kg) of internal fuel, a rather better load than the parallel Su-7 series, and supplemented by two drop tanks on side-by-side fuselage pylons. As in other interceptors with this radar/AAM system the missiles were carried on large underwing rails.

Compared with the Su-7 the delta proved faster but to need a long paved runway. Compared with the MiG-21 the Su-9 is much larger and more powerful, though using almost identical aerodynamics; the Su-9 has never had any close combat capability nor any known fitment of a gun or air/surface weapons, and its AAM pylons precluded the carriage of underwing tanks. Possibly the fastest of the original AL-7F aircraft was the T-405 which in May 1960 set a 100km (62-mile) closed circuit speed of 1,299mph (2,091km/h). By this time the AL-7F-1 was fully developed and in such aircraft as the T-37 and T-431 was reaching speeds close to 1,500mph (2,414km/h). The T-37, in fact, with a different engine, reached almost 3,000km/h (1,864mph) but the nearest ancestor to the next-generation interceptor was the PT-8 whose forward fuselage was simply fitted to the Su-9 to produce the Su-11, with the addition of the four auxiliary side inlet doors retained on all production Sukhois of this period including the Su-7. More important was the much more powerful Uragan 5B radar and armament of two 'AA-3 Anab' missiles, one being an IR homer and the other a radar-homing version. Though not in the same class as the MiG-25 and Tu-28P for radar range and AAM performance the Su-11 proved fully adequate for its PVO missions and remains in service in dwindling numbers to this day, with some 300 still in the active inventory, plus 100 or so Su-9U trainers. Large numbers of Su-9s have been converted as remotely piloted targets, and the remaining Su-11 regiments are steadily converting to the Su-15 and other types.

Right: Wintry weather does not mean taxiways are not kept clear, even if the interceptors are only of the Su-9 'Fishpot-B' type.

Below: Suited-up IA-PVO pilots followed by ground staff scramble a section of Su-9 interceptors on a practice mission.

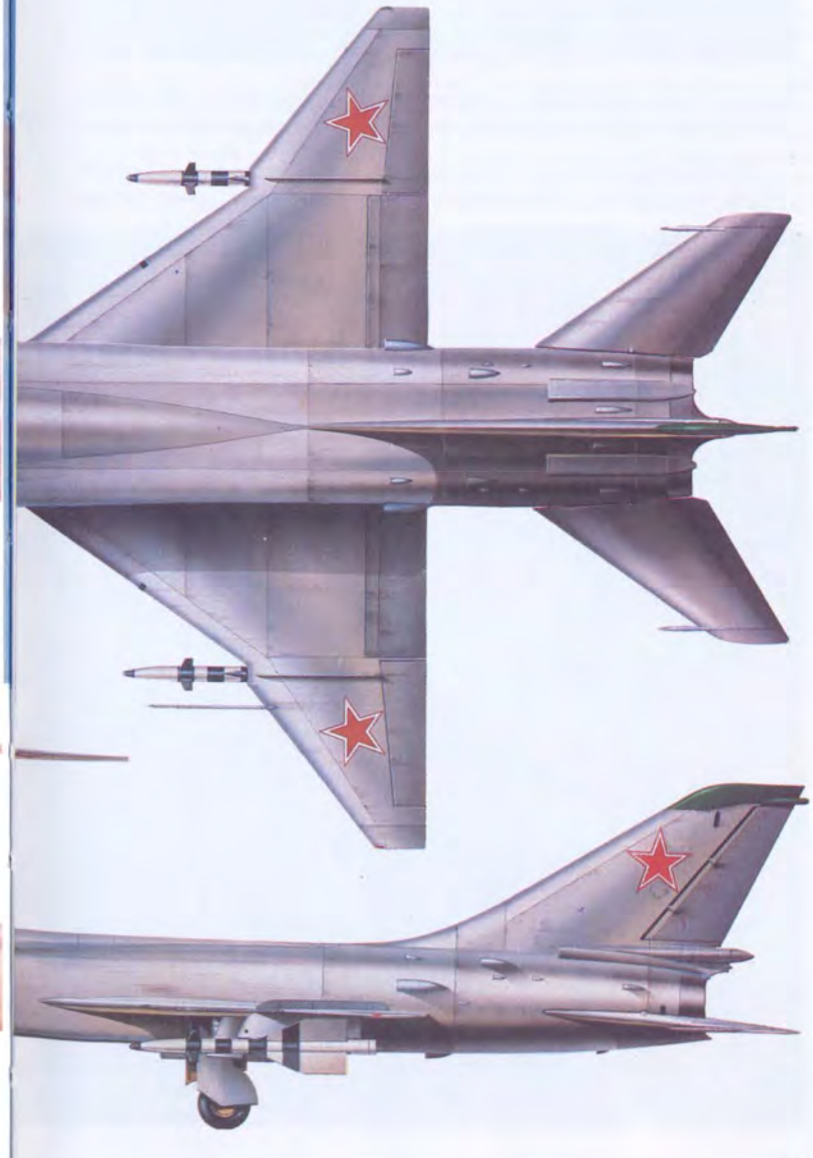
Sukhoi Su-15

Su-15 in six known variants called 'Flagon-A' to F

Origin: The OKB of Pavel O. Sukhoi.
Type: All-weather interceptor.
Engines: Two Tumanskii afterburning turbojets, (A to D) 13,668lb (6.2t) R-11F2-300, (E,F) 14,550lb (6.6t) R-13F-300.
Dimensions: Span (A) about 30ft 0in (9.14m), (others) 34ft 6in (10.5m); length (incl probe) 68ft 0in (20.5m); height 16ft 6in (5.0m); wing area 385sq ft (35.7m^2).
Weights: Empty (A) about 25,000lb (11.34t), (F) about 27,000lb (12.25t); loaded (A) about 35,275lb (16t), (F) about 40,000lb (18t), (F, max with external tanks) 44,900lb (20t).
Performance: Maximum speed (clean, 36,000ft/11km), (A) about 1,520mph (2,450km/h, Mach 2.3), (F) about 1,650mph (2,655km/h, Mach 2.5); (with AAMs) (A) about 1,400mph (2,250km/h, Mach 2.1), (F) about 1,520mph (2,450km/h, Mach 2.3); initial climb about 45,000ft (13.7km)/min; service ceiling about 65,600ft (20km); combat radius (hi) about 450 miles (725km); ferry range about 1,400 miles (2,250km).

Armament: Normally two 'AA-3A Anab' or 'AA-3-2 Advanced Anab' AAMs on underwing pylons (one IR homing, one radar homing); exceptionally, one pair of each type using body pylons in addition (performance figures are for two AAMs only); by 1982 aircraft in service probably equipped with later AAM, eg 'AA-7 Apex'.
History: First flight (prototype, designation unknown) probably 1964; (production Su-15) probably 1967. ▶

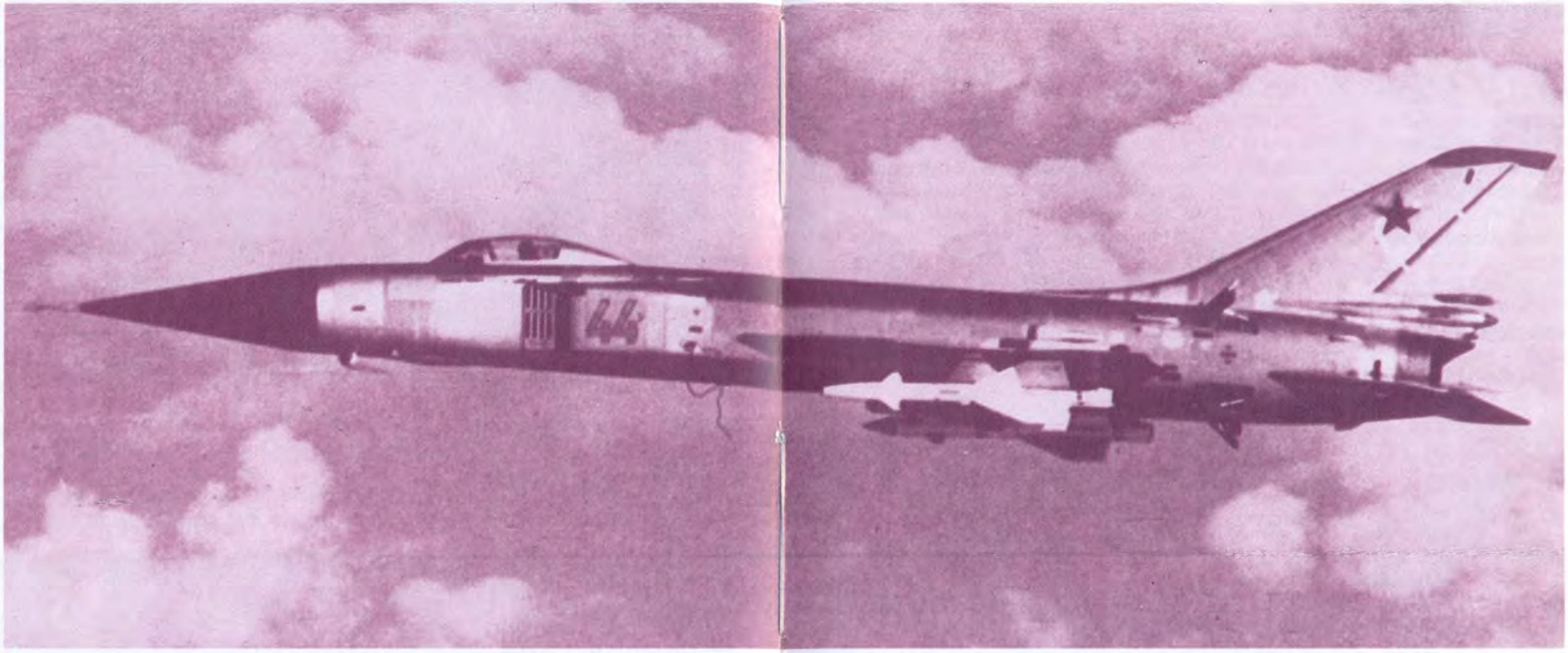
Below: Three-view of the latest known version of Su-15, with NATO reporting name 'Flagon-F'. Like Tornado F.2 this is a long-range killer, making no pretensions to having dogfight capabilities.



▶**Development:** This family of interceptors stemmed from prototypes flown in the mid-1960s to meet a VVS requirement for an aircraft to carry the same missiles as the Su-11 or Yak-28P but with higher speed and altitude. The Sukhoi OKB won this competition easily by using major parts of the Su-11 but fitting a much larger fuselage with lateral inlets to twin engines (the same engine as already in large-scale production for the MiG-21). As virtually nothing but the fuselage was new the risk was minimal, and the only ambitious part of the project was that it pushed up the scale of wing loading to a level never before seen in a Soviet production type, whilst at the same time achieving an impressive ratio of thrust to clean gross weight. The prototypes included at least one all-black machine, flown at the 1967 Aviation Day display by OKB chief test pilot V. Ilyushin (son of the rival OKB leader). Other prototype and pre-production machines included goldden-orange and scarlet examples used by VVS aerobatic teams, though this is not an aircraft for tight manoeuvres. The original production machine, called 'Flagon-A' by NATO, used almost the same wing and tail as the Su-11, but with structural strengthening, especially to the landing gear, and with more than three times the fuel capacity. The fully variable rectangular inlets slope outwards in front view, and the ducts curve in to give optimum Küchemann-type (Area Rule) flow across the wing whilst still leaving ample room for fuel between them. The engines are very much smaller than the single engine of the Su-11. The 'Flagon-B' was a STOL research aircraft with three lift jets in the centre fuselage in place of tankage, and a modified wing. 'Flagon-C' is the▶

Above: IA-PVO officers with a 'Flagon-D', the kinked wing of which is clearly visible, as are the large air inlets to cool the afterburner.

Below: Possibly a montage (common in Soviet publicity) this picture shows early 'Flagon-A' interceptors over a Bar Lock ground radar.

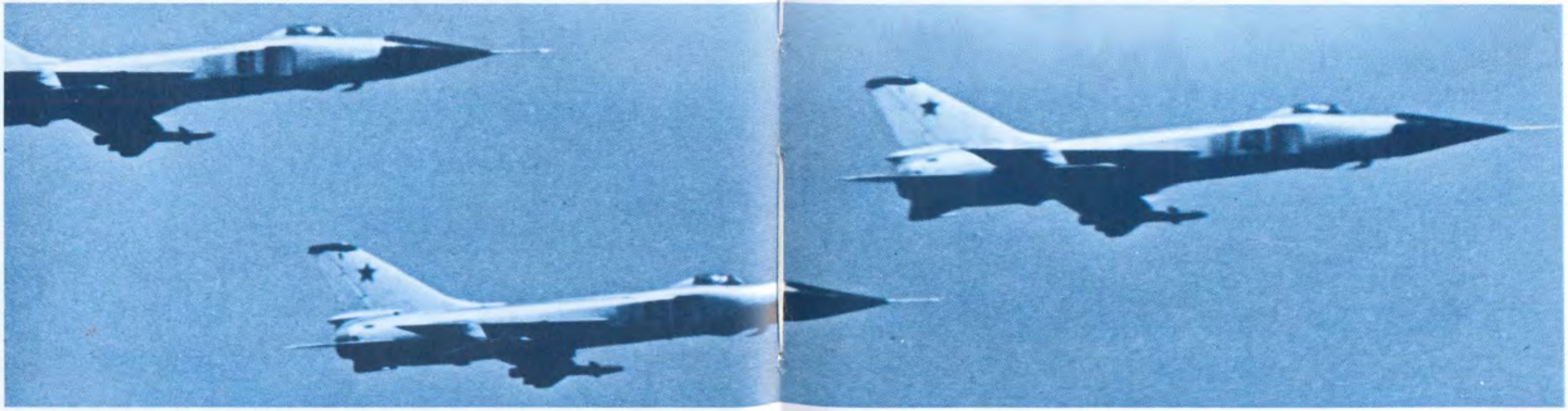


Above: The first major production model was so-called 'Flagon-D', with the new wing but retaining the conical radome and original radar.

▶standard dual trainer (probably Su-15U) with an added pupil cockpit replacing forward avionics and with tandem clamshell canopies, that of the instructor incorporating a large periscope fairing. 'Flagon-D' was the first series version, fitted with a wing of extended span first flown on the B version; new outer panels of reduced sweep are joined by short unswept portions giving a leading-edge 'soft dogtooth' upstream of the single fence. By 1973 this had been replaced by 'Flagon-E' with uprated propulsion and avionics, and this in turn was supplanted in 1976 by 'Flagon-F' (Believed to be the Su-15VD) with an ogival radome which, while giving more room for the mechanically scanned aerial, also offers lower drag. It is not known if a new radar has been fitted; certainly the J-band 'Skip Spin' (previously used in the Yak-28P) has been overdue for replacement, as have the 'Advanced Anab' missiles.

In the early 80s 'Flagon-E' and F were jointly the most important dedicated PVO interceptors, though numerically outnumbered by the various Mig-23 fighter versions which are widely used in addition by the FA. Lack of modern radar and AAMs giving look-down shoot-down capability has for a decade been the one big shortcoming of this otherwise extremely formidable aircraft. About 1,000 were built, of which some 700 were in PVO regiments in 1982. There is a very strong probability these will be electronically transformed over the next two years and fitted with modern long-range missiles.

Below: Three of the ten Su-15s which participated in the Aviation Day display at Domodyedovo in July 1967. Many were certainly prototypes.



Sukhoi Su-17

Su-17/-20/-22 variants

Origin: The OKB of Pavel O. Sukhoi.
Type: Ground-attack fighter.
Engine: (most) one Lyul'ka AL-21F-3 afterburning turbojet with ratings of 17,200/24,700lb (7.8/11.2t); (current variants) one Tumanskii R-29B afterburning turbojet with ratings of 18,960/27,500lb (8.6/12.5t) (estimated).
Dimensions: Span (28°) 45ft 11½in (14.0m), (62°) 34ft 9½in (10.6m); length (basic-17 incl nose probes) 61ft 6¼in (18.75m), (later variants) 62ft 9½in (19.13m), length of fuselage (inlet lip to nozzle) (-17) 50ft 6½in (late 5ft 9½in (15.78m); wing area (28°) 431.6sq ft (40.1m²).
Weights (estimated): Empty (Fitter-C) 22,050lb (10t), (-H) 22,500lb (10.2t); loaded (clean) (-C) 30,865lb (14t), (-H) 34,170lb (15.5t); max loaded (-C) 39,020lb (17.7t), (-H) 42,330lb (19.2t).

Performance: Maximum speed (clean, typical), (SL) 800mph (1,290km/h, Mach 1.05), (36,000ft/11km) 1,435mph (2,300km/h), Mach 2.17), (SL, with typical external stores) 650mph (1,050km/h); initial climb (clean) 45,275ft (13.8km)/min; service ceiling 59,050ft (18km); takeoff run at 17 weight, 2,035ft (620m); combat radius (-C, 2t bombload, hi-lo-hi) 391 miles ▶

Below: Three-view of the original Su-17 model of the VVS Frontal Aviation, with NATO name 'Fitter-C'. When this appeared nobody in the West thought it was the first of a prolific new swing-wing series.

▶(630km), (-H, 3t bombload, hi-lo-hi) 435 miles (700km); ferry range, four tanks (-C) 1,400 miles (2,250km), (-HO 1,700 miles (2,750km).
Armament: Two NR-30 guns each with 70 rounds and two Atoll or Aphid AAM; eight pylons (tandem pairs under fuselage, under LE of wing root and under wing-pivot fences) for total of 8,820lb (4t) external ordnance/tanks.
History: First flight (Su-22IG) 1966; (production -17) probably 1970.

Development: At the Domodyedovo display on Aviation Day 1967 a variable-sweep research aircraft based on the Su-7 was displayed. The modification called for a largely new wing, but only the outer part was pivoted, and that over a smaller than normal angular range. The benefits were judged by Western analysts to be minor, and the Su-22IG was forgotten as a 'one-off' research machine. In fact the careful revision of the whole aircraft, including fitting a more powerful engine, enabled twice the warload to be carried 30 per cent further than the limit with the Su-7 whilst operating from airstrips of little more than half the length. Though for the longer term the OKB was busy with the totally new Su-24, the swing-wing

Above: 'Fitter-J' is one of the latest versions of this family, seen here with the powerful Libyan Arab Republic AF. Carrying tanks and Advanced 'Atoll' AAMs it was photographed by the US Navy in 1981.

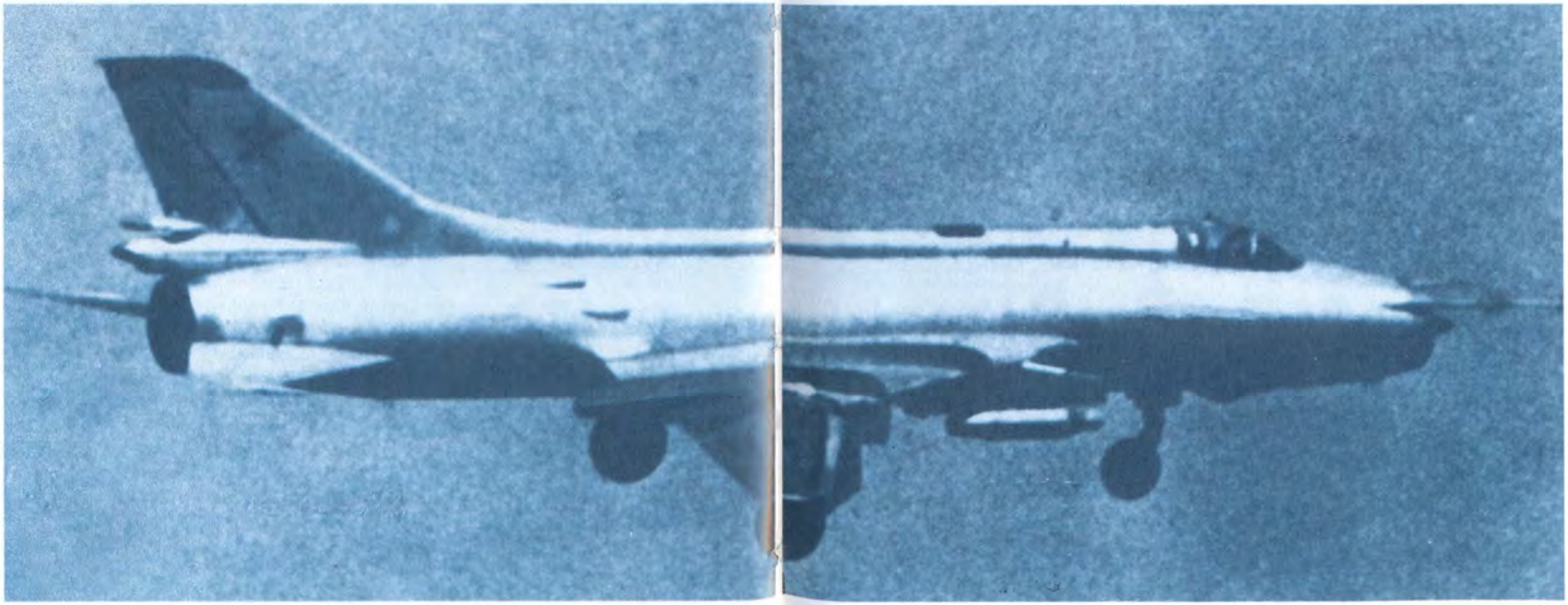
derivatives of the Su-7 continued to be updated with additional sensors, improved systems, airframe modifications, extra internal fuel and a newer engine, and in 1982 they remained in production as front-line aircraft with numerous regiments of the VVS and AVMF.

At least nine distinct variants had been identified by early 1981 but as their designations are unknown the reporting 'Fitter' codenames must be used. The basic VVS model, which entered service in 1971, is called by NATO 'Fitter-C'. This introduced the new wing and engine but retained maximum commonality in structure, systems and cockpit with the Su-7BMK. The centre section was enlarged, strengthened and divided into an inner portion with large plain flaps and an outer portion with sharp sweep on the trailing edge, without flaps. The outer wings, driven in unison from 16° to 62°, were fitted with full-span slats, slotted flaps (operative at 16° only) and powered▶

▶ailerons of almost unchanged form. The canopy was changed from a sliding teardrop to a clamshell leading into a dorsal spine, the centrebody was redesigned to translate automatically according to air-data instrumentation (also needed for enhanced weapon-delivery avionics) and filled with SRD-5M 'High Fix' radar, the instrumentation data being obtained by a pitot boom on the upper left of the nose and a pitch/yaw transducer boom on the right, internal fuel was incrased to about 8,200lb (3,720kg) partly by the dorsal spine, the pylons under the giant wing-pivot fences were plumbed for drop tanks (max four instead of two) and the avionics were greatly augmented and updated.

Avionics were further improved in 1976 with so-called 'Fitter-D' in which a lengthened and downward-sloped nose gave better pilot view and added a laser ranger and marked-target seeker (base of centrebody), terrain-following radar (front of new undernose fairing) and doppler (undernose fairing). 'Fitter-E' is a tandem dual trainer with the original nose and usually with only the right-hand gun. 'Fitter-F' is an export model. 'Fitter-G' entered FA regiments in 1979 and introduced the redesigned fuselage with a substantial (and vertically asymmetric) bulged aft portion believed to denote the R-29B engine and possibly the result of secondary cooling fed by a single ram inlet each side instead of three inlets. The -G is a two-seater and has a completely new deep forward fuselage, tandem upward-hinged canopies ahead of a very deep spine and a new vertical tail of greater height, plus a ventral fin. The corresponding single-seater is 'Fitter-H', known to be an Su-20 even though this number was previously used for simplified export models of 'Fitter-C'. The H variant has both guns and, as it has the extra fuselage tankage of the G without the penalty of the second seat, has internal capacity of about 11,000lb (5t). The FA is thought to have about 650 of the C, D and H models, and the AVMF about 40 H in the anti-ship role.

Right: More recently joined by later variants, the Su-20 (called 'Fitter-C' like the original Su-17) was the first export model of the family, one of the recipient air forces being that of Poland. These aircraft had a poor equipment standard.



Below: Another early swing-winger of basic 'Fitter-C' type, in this case serving with Soviet Frontal Aviation.

Sukhoi Su-24

Su-24; other variants not yet identified

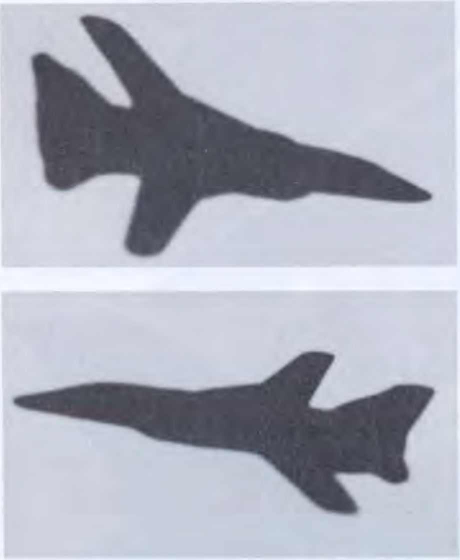
Origin: The OKB named for Pavel O. Sukhoi.
Type: All-weather attack and reconnaissance.
Engines: Two afterburning engines, almost certainly Tumanskii R-29B each rated at 18,960/27,500lb (8.6/12.5t).
Dimensions (estimated): Span (16°) 56ft 3in (17.15m), (68°) 31ft 3in (9.53m); length overall 69ft 10in (21.29m); height 18ft 0in (5.5m); wing area (16°) 500sq ft (46.4m²).
Weights (estimated): Empty 39,700lb (18t); loaded (clean) 64,000lb (29t); maximum loaded 87,080lb (39.5t).
Performance: Maximum speed (clean, 36,000ft/11km) 1,590mph (2,560km/h, Mach 2.4), (clean, SL) about 870mph (1,400km/h, Mach 1.14); (max external load, hi) about 1,000mph (1,600km/h, Mach 1.5), (max external load, SL) about 620mph (1,000mph (1,600km/h, Mach 1.5), (max external load, SL) about 620mph (1,000km/h, Mach 0,815); service ceiling (with weapons) 57,400ft (17.5km); combat radius (lo-lo-lo, 8t bombload) 200 miles (322km), (hi-lo-hi, 2.5t bombload) 1,115 miles (1,800km); ferry range (six tanks) about 4,000 miles (6,440km). ▶

Below: Though prepared in 1977 this drawing was amazingly accurate; the only wrong guess was that the nose gear retracts rearwards.

▶**Armament:** two (possibly one) cannon of unidentified types recessed into underside of fuselage; normally eight pylons (four fuselage, two glove and two pivoting on wings) for at least 17,635lb (8t) external load including all known Soviet free-fall tactical weapons and ASMs.
History: First flight (prototype) about 1970, (production Su-24) 1973.

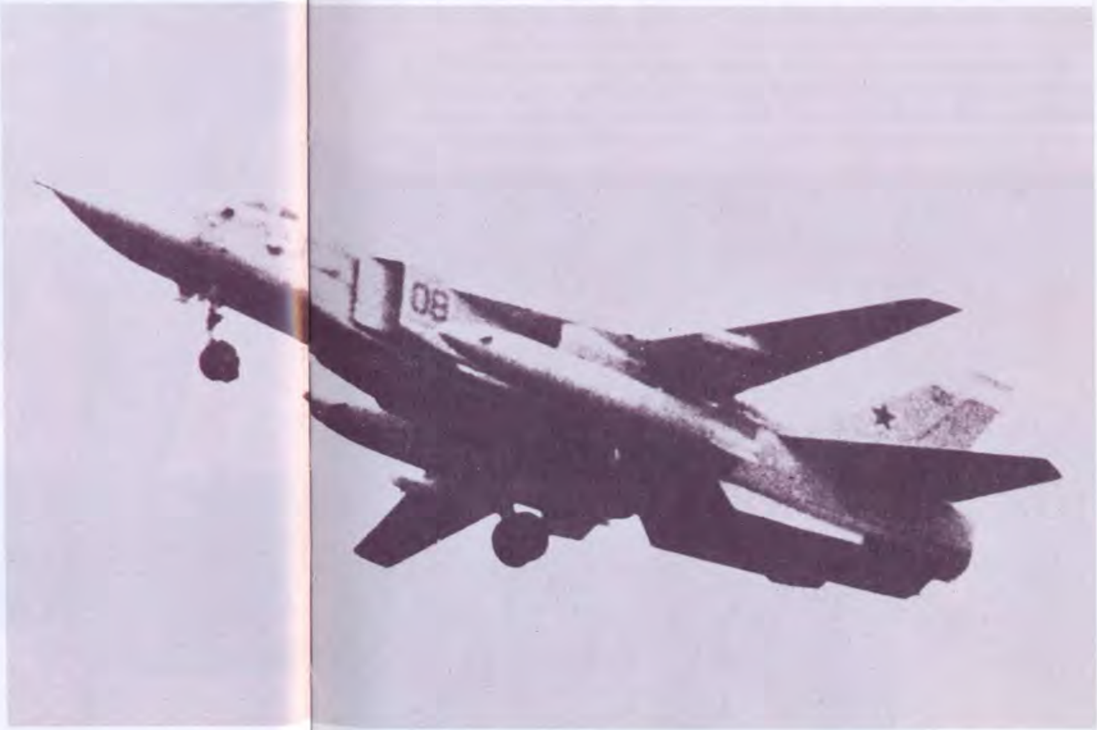
Development: At first thought to be the Su-19 (a fighter designation, because an odd number) and misleadingly given the NATO code name 'Fencer' (a fighter name, beginning with F), this aircraft in fact was planned as a counterpart to the F-111 or IDS Tornado as a most formidable long-range all-weather attack aircraft able to make blind first-class strikes against point targets. Its aerodynamics are those previously used by the MiG OKB for the MiG-23 series, but the horizontal tailerons are slightly higher (at wing level), the wings and tailerons are closer together and the outer wings have no dogtooth and extended-chord leading edges and thus are of higher aspect ratio, for more efficient long-range cruise. For the first time in a Soviet tactical aircraft, and emulating the F-111, the pilot and navigator sit side-by-side, this being made possible by the size of the flat scanner of the extremely powerful pulse-doppler radar, and in turn giving room between the inlet ducts for a considerable amount of fuel. Total internal capacity is about 2,860gal (13,000lit), and this can be supplemented by two drop tanks of some 330gal (1,500lit) size on the glove pylons and a further pair on the outer wings for ferrying. The outer-wing pylons were the first pivoting pylons on a Russian aircraft and all eight pylons appear to be of the same force-ejector type with a store rating of 2,205lb (1t). The wings have full-span slats and flaps, and there are three-section upper-surface spoilers/lift dumpers. All units of the landing gear have twin wheels as exclusively forecast in Salamander's 'Soviet Air Power' in 1978 which also guessed correctly at the form of the fully variable inlets with auxiliary suck-in doors in the outer walls. There is an almost flat underside, the inlets filling the depth of the fuselage, and towards the rear there is a vertical ventral fin on each side. Two guns of different sizes appear to be recessed in the underside alongside the tandem forward pylons, each gun being faired by a large blister, the central portion of which is both an access door and, in the air, an airbrake.

Essentially the Su-24 is a bomb truck, but one with very long range and high speed, and (though information is still very incomplete) extremely comprehensive avionics for all-weather blind navigation, terrain following and delivery of free-fall or smart ordnance. The radar is the most powerful known to be flying on any tactical aircraft and is unrelated to any previously identified Soviet set. Basic navigation is certainly inertial, and the main forward-looking attack radar and terrain-following radar are probably backed up by a doppler, laser and FLIR or EO equipment, though the latter may be added in conformal pods. There is certain to be an internal ECM/EW suite, and it must use flush aerials throughout because most of the familiar radar homing/warning, IFF, ILS and similar avionic aerials are not to be seen. Far from this meaning the avionics are austere, they are unquestionably a new generation throughout, the crew-member in the right-seat being a weapons-systems officer. The engine and gun types have yet to be positively identified; there may be only one gun but the arrangement of fairings and blast channels indicates a gun of about 30mm calibre on the left and about 23mm on the right, for different types of target. The US Defense Department revised its size estimate upwards in 1981 (to a swept span of 10.2m, for example) and stated that in spring 1981 about 400 Su-24s were with front-line regiments.



Above: For historical interest, these silhouettes became available to the West in 1980 and significantly added to NATO knowledge of the Su-24—which until that time had been incorrectly thought to have a fighter designation, Su-19.

Below: Good photographs of the Su-24 at last became available in 1981, following a brief detachment of at least part of a regiment to Templin, East Germany. This aircraft in the circuit, with flaps up, is carrying extremely large drop tanks with small nose fins.



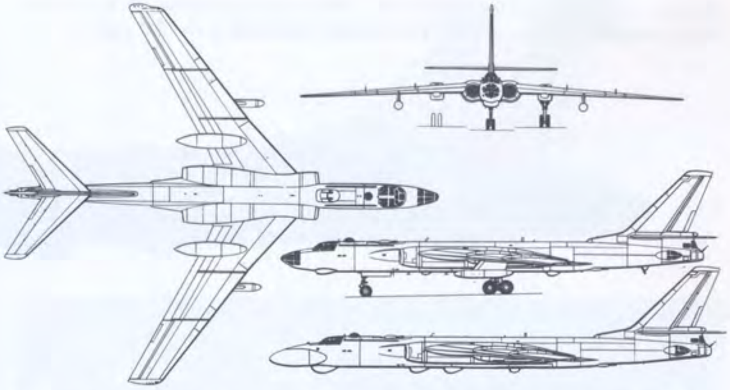
Tupolev Tu-16

Ten variants, 'Badger-A' through -K

Origin: The OKB of Andrei N. Tupolev.
Type: Originally strategic bomber; today, various (see text).
Engines: Two 20,950lb (9.5t) thrust Mikulin RD-3M turbojets.
Dimensions: Span (basic) 108ft 0½in (32.93m), (almost all current variants) 109ft 11in (33.5m); length (basic) 1,14ft 2in (34.8m), (D) 120ft 9in (36.8m); height 35ft 5in (10.8m); wing area (basic) 1,772sq ft (164.65m²), (current variants) 1,819sq ft (169m²).
Weights: Empty (basic -A) 81,570lb (37t), (typical modern variant) 92,590lb (42t); maximum loaded (-A) 158,730lb (72t), (all known current variants) 169,755lb (77t).
Performance: Maximum speed (typical current variant, 30,000ft/9km and above) 587mph (945km/h); long-range cruise 485mph (780km/h); service ceiling (typical) 42,650ft (13km); range (typical, max fuel) 3,980 miles (6,400km), (with missile/bomb load) about 2,980 miles (4,8000km).
Armament: (-A) seven NR-23 cannon in three twin barbettes with one fixed firing ahead; bomb load of up to 19,180lb (9t); (modern versions) various, see text.
History: First flight 1952; entry to service 1955.

Development: One of the largest twin-engined bombers in history, this aircraft, with OKB number Tu-88, posed several major challenges at the time of its design in 1950. One of the challenges was structural, yet like its contemporary the B-52 it has remained in service to this day and numerous examples must have logged more than 10,000 hours. Like the B-52 it began as a free-fall strategic bomber and was later developed as a platform for cruise missiles of several kinds, but in addition the ten known variants included dedicated reconnaissance, maritime patrol, ECM and Elint configurations, all using the same basic airframe and systems.

Its ancestry can be traced back through intermediate types to the Tu-4, a pirated copy of the B-29. Like that aircraft it has a basically circular-section fuselage with pressure cabins at the nose for most of the crew (originally for five or six) and at the tail (for the gunner, in some aircraft accompanied by a



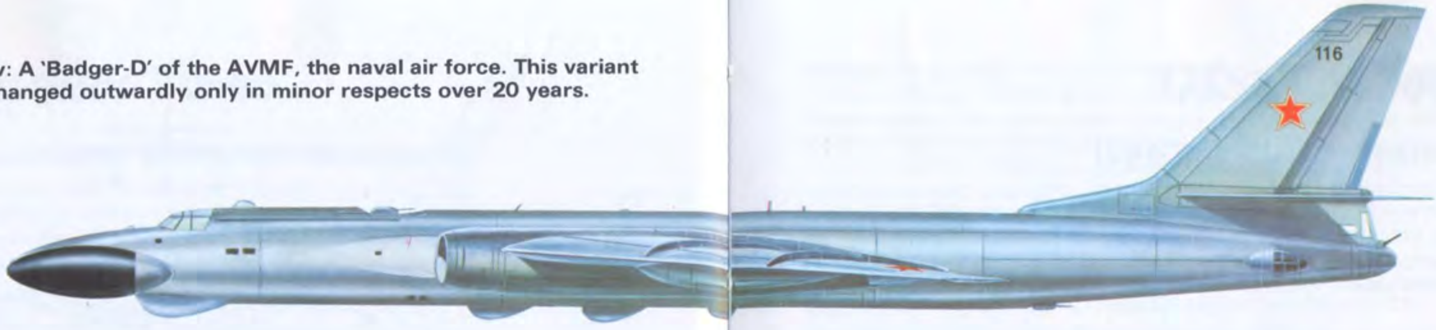
Above: Three-view of 'Badger-F' with side view (lower) of 'Badger-D'.

second man for ECM or Elint management, visual observation or other duties). The mid-fuselage contains the weapon bay with tankage above, further tanks being between the spars of the 42°/35° wing. With this aircraft Tupolev set a pattern of using bogie main gears folding rearwards into large streamlined fairings behind the wings. The engines occupy the rear part of large ducts at the wing roots, curving inwards from the inlets and outward again at the engines to keep the jets well away from the rear fuselage. The use of a forward-firing cannon was a continuation of established Soviet practice, and remarkably appears still to be fitted, as do the three pairs of barbette-mounted guns.

The original series aircraft, called 'Badger-A' in the West, could carry any of 18 types of conventional and nuclear bombs in a single bay 21ft (6.5m) long. It is not known how many of the 2,000-odd Tu-16s built were originally of this type, but none is thought to be still in combat service (except generally similar Chinese-built examples). Some A-models were converted as air refuelling tankers with a hose trailed from the right wingtip or from a weapon-bay hosereel, the receiver aircraft having an extended tip to the left wing incorporating the hose receiver socket. Almost all aircraft today have ▶

Left: A Tu-16 of the so-called 'Badger-F' type photographed by a Western aircraft at low level over the Atlantic. The pylon-mounted pods are part of the comprehensive Elint (electronic intelligence) system. Unlike some RAF and other NATO bombers of the same vintage the Tu-16 appears to have suffered from no serious structural problems, and there is no immediate plan to start withdrawing these aircraft from operational service. Flight times are probably about 10,000 hours for the older specimens, though modifications and rebuilds introduced new parts.

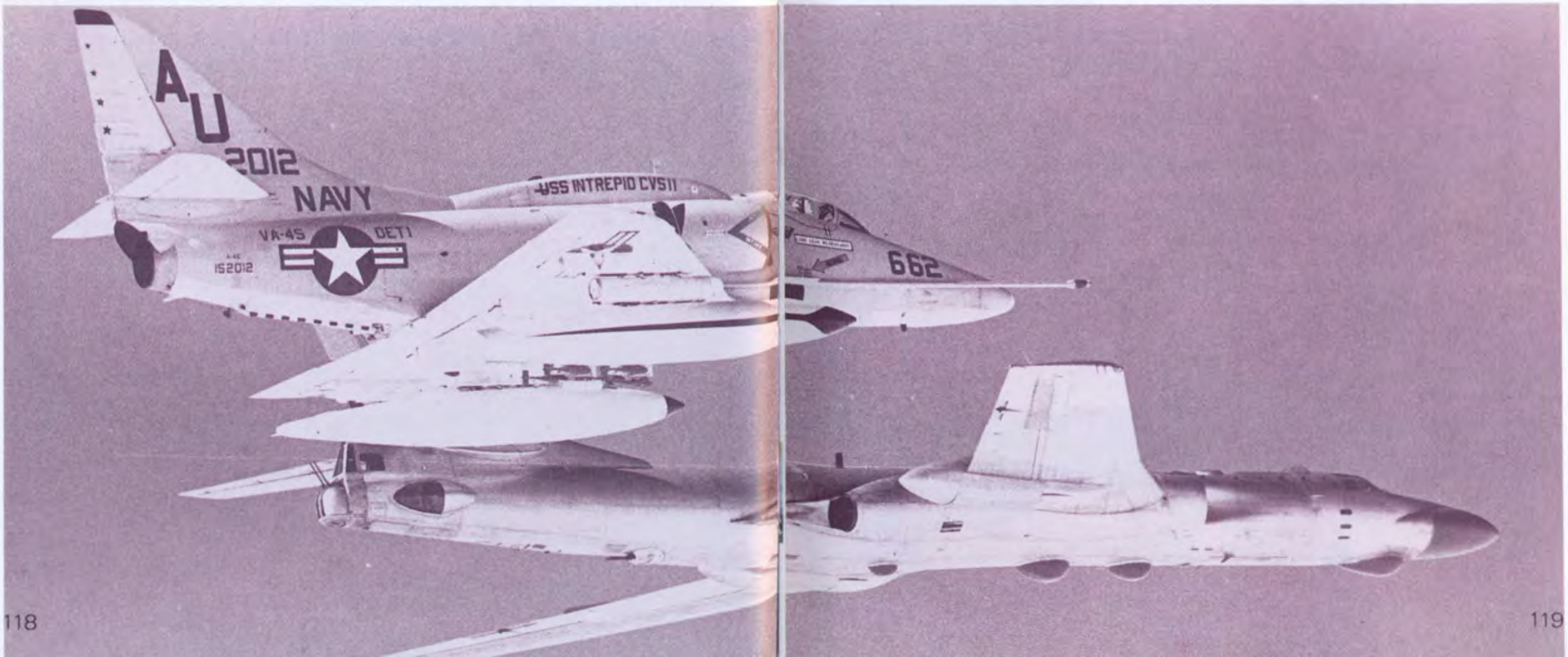
Below: A 'Badger-D' of the AVMF, the naval air force. This variant has changed outwardly only in minor respects over 20 years.



▶ this extended left wingtip, which is not compatible with M-4 hose drogues. Badger-B carried two 'AS-11 Kennel' ASMs under its wings and is no longer used. Badger-C carried the large 'AS-2 Kipper' ASM under the fuselage and had a large radar in place of the glazed navigator nose station; today this variant carries an 'AS-6 Kingfish' under either wing. The -D model, still in the inventory, is a maritime surveillance and missile-guidance platform, with the same nose radar, an enlarged chin radar and three ventral aerial fairings. Badger-E is a reconnaissance aircraft with a glazed nose and large camera pallets in the bomb bay and, in recent years, with other sensors in addition. The -F model is an Elint aircraft based on the -E with added receiver pods on deep wing pylons. Badger-G is an important ASM platform, originally armed with two 'AS-5 Kelt' missiles on modified AS-1 pylons and today with numerous (mainly internal) modifications and either one or two 'As-6 Kingfish' missiles on the wing pylons (single missiles are carried either on the left or right), with a large belly radome and a large external device on the nose. Badger-H is a strategic ECM/EW aircraft believed to be used mainly for dispensing large volumes of chaff cut to length on board according to signals received from hostile emitters via ventral aerials. The J variant (I was omitted) is a high-power jammer, with the main generation and transmitting system in a belly canoe radome. Badger-K is a special Elint model, again with front and rear ventral blisters. The DA is at present flying some 300 with offensive capability, plus a few tankers and 90 ECM/EW models. The AVMF has 275 for maritime attack, 70 tankers and 40 recon and EW versions.

Above: One of the first of the 'Badger-G' type to carry the 'Kingfish' missile; subsequently modified examples of this variant appeared.

Below: A 'Badger-D' of the AVMF escorted by a US Navy A-4E. This is a maritime electronic reconnaissance and Elint variant.

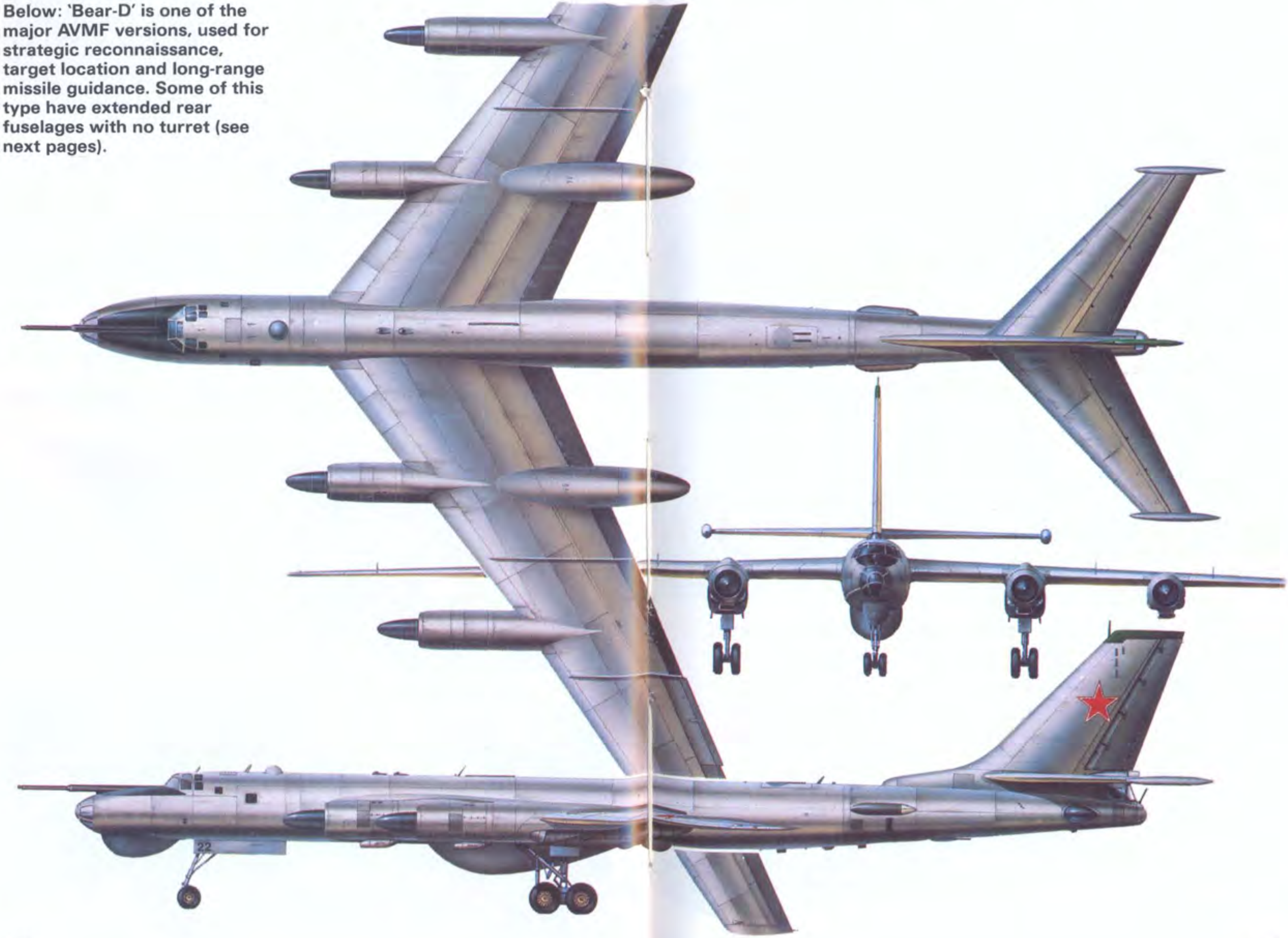


Tupolev Tu-20

Six variants (Tu-95 and -142)

Origin: The OKB of Andrei N. Tupolev.
Type: (Three variants) strike, (two) reconnaissance, (one) ASW.
Engines: Four 14,795ehp Kuznetsov NK-12M series (believed -12MV) turboprops.
Dimensions: Span 167ft 8in (51.1m); length (most) 155ft 10in (47.5m), ('Bear-F') 162ft 5in (49.5m); height 39ft 9in (12.12m); wing area 3,342sq ft (310.5m²).
Weights (estimated): Empty (A) 165, 400lb (75t), (F) 178,600lb (81t); maximum loaded (A) 374,800lb (170t), (F) 414,500lb (188t).
Performance: Maximum speed (typical, half fuel, over 26,000ft/8km) 525mph (845km/h); high-speed cruise 435mph (700km/h); service ceiling (typical) 44,300ft (13.5km); typical range/payload, 7,020 miles (11,300km) with military load exceeding 26,455lb (12t); unrefuelled combat radius in recon/EW mission 5,150 miles (8,300km); endurance at econ cruise speed of 400mph (650km/h), 28 hours.
Armament: (A) Six NR-23 guns in three remotely controlled barbettes; internal bay for ordnance load of up to 44,100lb (20t); (later variants) see text.
History: First flight 1954; service entry late 1956. ▶

Below: 'Bear-D' is one of the major AVMF versions, used for strategic reconnaissance, target location and long-range missile guidance. Some of this type have extended rear fuselages with no turret (see next pages).



▶**Development:** One of the most impressive aircraft of all time, this unique swept-wing turboprop bomber amply met all the original DA requirements for intercontinental range with a heavy load of free-fall bombs, combined with high speed and over-target height. Like the much shorter-ranged Tu-16 it was subsequently developed, both by conversion and by manufacturing additional new aircraft in the 1970s, for fresh strategic duties, and almost all surviving aircraft continue in front-line service with no replacement in sight (the 'Ram-P' swing-wing jet could not even approach the range and endurance of these majestic machines).

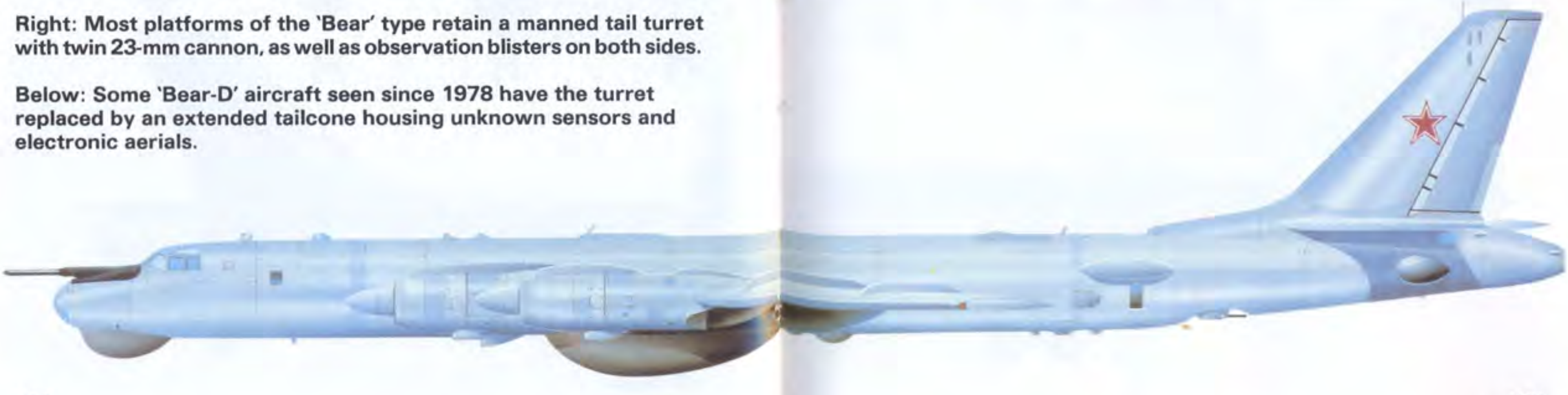
There has been prolonged confusion over such basics as the size and designation of these aircraft. There is no doubt whatever that the original aircraft had the OKB number of Tu-95, and it was essentially a Tu-85 with a new all-swept wing and tail and powered by the remarkable NK-12 turboprop which matured in 1954 at 12,000hp, driving two separate four-blade AV-60N propellers of 18ft 4in (5.6m) diameter rotating in opposite directions. The leap of 300 per cent in installed power opened the way to a considerable increase in the already enormous fuel capacity, and actually reduced takeoff run despite the switch to a swept wing. The Tu-85 fuselage, derived via intermediate stages from the Tu-4 (B-29), accommodated nose, mid and tail pressure cabins for a crew of 16, made up of two crews of eight to fly long missions. Some Tu-95 variants, however, use single crews numbering from seven to 12. Typical wing-box fuel capacity is 16,540gal (72,980lit), and features include Fowler flaps, powered controls, bogie main gears retracting rearwards into trailing-edge fairings, thermal ice protection, and a tunnel linking the front and mid crew compartments.

At first the span was estimated in the West at 180ft, and the new bomber was given the reporting name 'Bear'. Then span was revised to 163ft and then for many years said to be 159ft even though the same wing was known to have a span of 167ft 8in on the Tu-114 airliner. The VVS designation was Tu-20, but in 1979 the SALT 2 talks caused the Soviet Union to resurrect the OKB numbers, 95 for the original aircraft and 142 for a new ASW version (it is widely supposed that 142 is the number of all AVMF examples, even those built as 95s) in order to get a major part of the force immune to SALT restrictions on strategic platforms. If the OKB numbers are now used as service designations this would be unique, in a land noted for being methodical.

All six models continue in service. So-called Bear-A is a DA bomber, with the original weapon bay, two sight stations for the guns and provision for an FR probe. Bear-B was modified to carry and launch the 'AS-3 Kangaroo', the largest ASM ever built, with range of 404 miles (650km); according to the US Defense Department this continues in service (contrary to the available evidence), but most of this variant have been converted to carry the smaller 'AS-4 Kitchen' and several are on other duties including multi-sensor reconnaissance, air-cloud sampling and strategic meteorology. Total DA inventory of -A and -B is about 113. Bear-C is a maritime reconnaissance aircraft with a blister fairing on both sides of the rear fuselage (often seen on the right side only on the -B variant) and with the FR probe invariably installed. Bear-D covers a wealth of variations on an important AVMF type carrying a very large electronic payload but no weapons. The weapon bay is occupied by the largest radar of its type in history (exceeded only by Awacs radars); there are at least 40 other aerials, blisters or dielectric fairings and in some aircraft the tail turret is replaced by a long fairing for further electronicsd. About 50 are used for reconnaissance and providing mid-course guidance to cruise missiles launched from distant warships. Bear-E is a rbuild for strategic reconnaissance, usually with the rear part of the bomb bay occupied by six/seven large cameras and with various other sensors. The newest aircraft are all of the Bear-F (Tu-142) type, built in the 1970s and incorporating numerous major and minor changes including extra fuel, a longer forward fuselage, bigger main-gear fairings and bulged nosewheel doors to accommodate the larger tyres, a further very comprehensive array of radars and other sensors (including, in some aircraft, a fairing extending aft from the tip of the fin) and a rear fuselage full of sonar gear in place of the upper/lower guns. These are dedicated ASW aircraft, about 40 being in use.

Right: Most platforms of the 'Bear' type retain a manned tail turret with twin 23-mm cannon, as well as observation blisters on both sides.

Below: Some 'Bear-D' aircraft seen since 1978 have the turret replaced by an extended tailcone housing unknown sensors and electronic aerials.



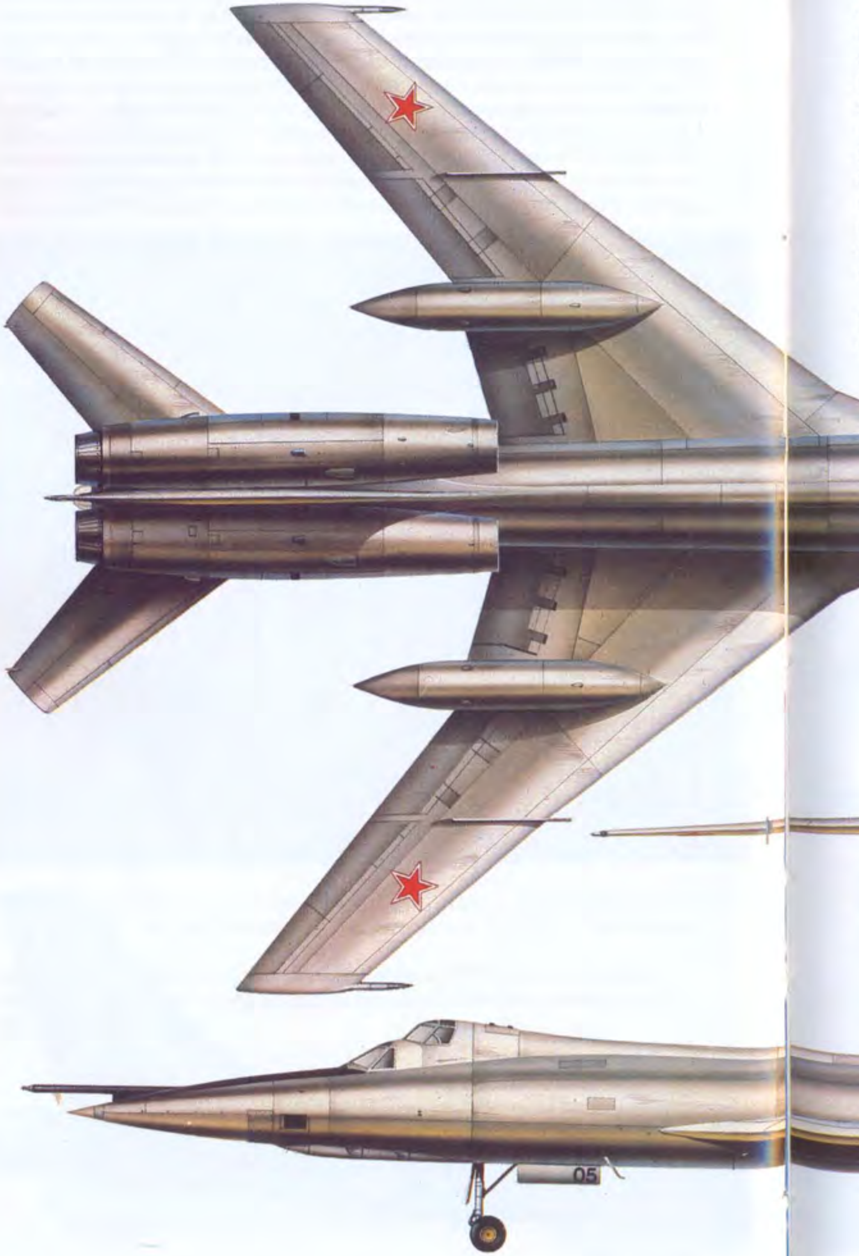
Tupolev Tu-22

Four known variants (NATO 'Blinder-A' to -D)

Origin: The OKB of Andrei N. Tupolev.
Type: (A) recon/bomber, (B) missile carrier, (C) maritime recon, (D) trainer.

Engines: Two large afterburning turbojets (believed to be Koliesov VD-7 or -7F) with rating of up to 30,865lb (14t) each.
Dimensions (estimated): Span 91ft 10in (28.0m); length 136ft 2in (41.5m); height 34ft 0in (10.4m); wing area 1,650sq ft (155m^2).
Weights (typical, estimated): Empty 90,700lb (40t); internal fuel 79,360lb (36t); maximum takeoff 185,000lb (84t).
Performance: Maximum speed (36,000ft/11km) 1,000mph (1,600km/h, Mach 1.5), (US Department of Defense estimate, 800kt = 920mph/1,480km/h); maximum speed at SL, 550mph (890km/h); typical hi-alt cruise 560mph (900km/h); service ceiling (afterburner) 60,000ft (18km), (dry power) 45,000ft (13.7km); unrefulled combat radius (all-hi, US DoD estimate), 1,926 miles (3,100km); maximum range (all-hi, no supersonic dash) 4,040 miles (6,500km).
Armament: (A) one 23mm gun in tail; internal bay for up to about 17,600lb (8t) of various bombs or, after conversion, as (B); (B) as (A) but weapon bay configured for one 'AS-4 Kitchen' ASM, and with larger radar; (C) multisensor naval reconnaissance aircraft with six cameras and EW systems in bomb bay, smaller radar and numerous added receivers for Elint mission; (D) dual-pilot training variant with instructor cockpit added at higher level behind original cockpit, with small radar and no known weapon/sensor capability. There is also a maritime anti-ship and strike variant with missile ▶

Below: The Tu-22U, or 'Blinder-D', is a pilot conversion trainer which normally has full avionics and weapons apart from nose radar.



▶capability, a dedicated EW platform and, at least in prototype form (but not in service), a long-range interceptor version.
History: First flight (Tu-105) 1959; service entry, probably 1963.

Development: As a contemporary of the B-58 and Mirage IVA, and closer in capability to the former, the Tu-15 was one of the world's first large supersonic bombers and was a straightforward design with a light-alloy airframe of beautiful area-ruled shape, with variable geometry confined to the engine nozzles (for takeoff the inlets are translated forward to admit more air, but that hardly counts). A remotely controlled gun was retained for rear defence, and it has been speculated this may have a chaff-firing function. Aerodynamically the wing is similar to the contemporary (Tu-102), with broad plain flaps inboard and outboard of pods for the bogie main gears, but on the bomber the ailerons extend almost to the tips. The crew of three sit in tandem ejection seats, firing downward, the navigator having glass windows on each side behind the main radar. This radar can be of either of two principal types, the 'Short Horn' nav/bomb set or the 'Dawn Beat' with acquisition/guidance function for the 'AS-4' and possibly other

Above: An unusual shot of a Tu-22 'Blinder-B' flying at low level with its 'Kitchen' missile in place. Though this missile is used by the AVMF most 'Blinder-B' aircraft appear to serve with the DA.

missiles. Almost all variants have provision for a flight-refuelling probe above the nose, and common fitments include a weapon bay with removable skin panels for conversion to missile carrying, cameras and ECM payload dispensers in the main-gear pods, doppler navigation radar, comprehensive EW equipment and the definitive engine with long variable nozzle flaps faired tightly into the cowl. Between 250 and 320 of all versions are estimated to have been built, all survivors remaining in front-line regiments of the DA and AVMF. It has taken almost 20 years to eradicate the ridiculously estimates of Tu-22 range originally published in the West, and the best consensus is that mission radius exceeds that of its partner the Tu-16, with similar payloads. The two have worked together for 20 years, the DA strength numbering about 150 (mainly of the B model but also including A, said to have a hi-lo-hi mission range of over 2,980 miles (4,800km) with an 8,380lb (3.8t) bombload, as well as a land reconnaissance model), and the AVMF force including about 40 each of Blinder-C and the anti-ship attack version. There is no evidence of production (by conversion) of the interceptor variant. The Tu-22 was the basis of the Tu-22M swing-wing family, and the first 22M prototypes were probably conversions.

Above: Takeoff by a 'Blinder-D' (probably the Tu-22U), used by both the DA and AVMF. Most Tu-22s of all variants appear to be unpainted.

Below: Profile drawing of an AVMF Tu-22 of 'Blinder-A' type, with FR probe.

Tupolev Backfire

Tu-22M, Tu-26

Origin: The OKB named for Andrei N. Tupolev.
Type: Strategic attack and reconnaissance.

Engines: Two afterburning turbofans, almost certainly versions of the Kuznetsov NK-144 each rated at over 44,090lb (20t) with maximum augmentation.
Dimensions (estimated): Span (20°) 113ft 0in (34.5m), (55°) 86ft 0in (26.2m); length overall 137ft 10in (42.0m), (without probe) 132ft 0in (40.23m); height 33ft 0in (10.1m); wing area (20°) 1,830sq ft (170m²).
Weights (estimated): Empty 120,000lb (54.4t); internal fuel 125,500lb ▶

Below: In this drawing of a Tu-22M or Tu-26 of the AVMF some items, such as main landing gears, are speculative. Missile is 'Kingfish'.

▶ (57t); maximum takeoff 269,000lb (122t).
Performance (estimated load, recessed or internal): Maximum speed (36,000ft/11km and above) 1,320mph (2,125km/h, Mach 2), (SL) 680mph (1,100km/h, Mach 0.9); high-speed cruise (med/hi level) Mach 0.9; normal cruise 560mph (900km/h); service ceiling (afterburner) 62,300ft (19km), (dry) 55,000ft (17km); unrefuelled combat radius (DoD figure) 3,420 miles (5,500km); maximum range 7,500 miles (12,000km).
Armament: Twin 23mm guns in remotely aimed tail barbette; either one 'AS-4 Kitchen' or 'AS-6 Kingfish' missile recessed under fuselage, or two similar missiles on glove pylons, or load of up to about 26,455lb (12t) in weapon bay and on external racks under inlet ducts.
History: First flight (22M) not later than 1969, (26) probably 1972.

Development: The first two prototypes of a new Tupolev bomber with variable-sweep outer wings were seen by US satellite in mid-1969. The fact that such aircraft were derived from the Tu-22 appeared to elude Western observers both then and since, with the result that the designation Tu-22M was greeted with incredulity when it was mentioned by Soviet documents in the SALT 2 negotiations. By this time the production aircraft had emerged, showing such slight resemblance to the Tu-22 that the designation was widely considered spurious. In fact, like most things Russian, the whole programme has been entirely logical. Though the Tu-22 was a valuable and reliable aircraft its combat radius could be greatly increased, and field length cut by over 35 per cent, by fitting variable-sweep outer wings. Work is believed to have begun in the mid-1960s, and the final aircraft, at once given the Western reporting name 'Backfire', also featured larger engines fed by long inlet ducts (faintly resembling those of the earlier Tu-98 and -102) giving the appearance of an extremely broad box-like fuselage.

The development fleet, probably built as new rather than rebuilt from Tu-22s, numbered about 12 aircraft and are generally believed to have eventually (1972-75) equipped an operational DA unit. But early in the 1970s the decision was taken to effect a more thorough redesign to increase internal fuel capacity and reduce drag, the chief outward change being redesign of the main landing gear to fold inwards into the fuselage under the centre section. The modified aircraft, with considerably expanded capability, is called 'Backfire-B' in the West, and is believed to have service designation Tu-26 though this is not yet confirmed. OKB numbers for either version are unknown, though Tu-116 has been suggested for the original 'Backfire-A' model. In 1975 the definitive aircraft entered production, initially at a reported 30 per year according to the SALT 2 treaty, but subsequently reported to have increased to 42 per year. What has not been explained is how in 1981 the DA had only 'about 70' of these aircraft, and 'a like number' in the AVMF, the number built by late 1981 cannot be less than 220, of an expected total of about twice this number.

Today this is the most formidable offensive aircraft in service with any country, with the internal fuel capacity (fuselage, wings and fin) to reach targets nearly 2,000 miles from base whilst carrying a powerful offensive load of bombs or missiles, and with internal ECM and EW systems still not fully analysed by the West but certainly more comprehensive than those carried by any other attack aircraft. Most examples have from 28 to 35 electronic aerials, almost all of them flush or of the low-drag blade type but including a major radar (reported to be of the missile-guidance 'Down Beat' family) and no fewer than five (possibly six) aerials facing to the rear. Unlike the Tu-22 the navigator sits aft of two side-by-side pilots and alongside the defence-systems operator who manages the EW systems and guns. It is believed they enter via a ventral door but have upward-ejection seats. As in the Tu-22 the FR probe is above the nose, but on many training missions of limited duration it is not fitted. A glance at the map will show that these aircraft can cover targets almost anywhere in Europe, the North Atlantic, North Pacific, China, Japan, Alaska, Canada and the Middle East and India. With flight refuelling the USA becomes a target, but they were not designed for such missions; the USA offers almost entirely fixed targets which are amply covered by ICBMs. It so happens that of roughly 20 Backfires seen in the West those with odd tail numbers have external bomb racks and those with even numbers carry a centreline missile, but that may be coincidence. Almost all these have been AVMF aircraft.

Right: Air-to-air picture of an AVMF 'Backfire-B' carrying a version of 'AS-4 Kitchen' under the centreline. (Photo by Swedish AF).

Below: This aircraft is of the same type as that depicted above, with a single 'Kitchen' type missile semi-submerged under the belly.

Tupolev Tu-124

Tu-124K and K2

Origin: The OKB of Andrei N. Tupolev.
Type: Passenger transport.
Engines: Two 11,900lb (5.4t) thrust Soloviev D-20P turbofans.
Dimensions: Span 83ft 10in (23.55m); length 100ft 4in (30.58m); height 26ft 6in (8.08m); wing area 1,285sq ft (119.37m²).
Weights: Empty about 50,000lb (22.7t); maximum payload 13,228lb (6t); normal loaded 80,470lb (36.5t); maximum 83,775lb (38t).
Performance: Maximum speed (over 32,800ft/10km) 603mph (970km/h, Mach 0.9); max cruising speed 540mph (870km/h, Mach 0.818); economical cruise 497mph (800km/h, Mach 0.75); takeoff/landing ground roll, about 3,280ft (1km); range with maximum fuel and 7,716lb (3.5t) payload, 1,305 miles (2,100km); range with max payload at econ cruise, 760 miles (1,220km).
Armament: None.
History: First flight June 1960.

Development: Looking extremely similar to the pioneer Tu-104 jetliner, which was derived from the Tu-88 bomber, the Tu-124 was in fact a completely fresh design on a reduced scale of size and with more efficient turbofan engines (it was the first turbofan airliner in the world, apart from earlier designs re-engined). Like most Soviet transports it had to be capable of operation from short unpaved airstrips with few facilities, though surprisingly it relies totally on ground stairways. Civil examples, which entered service in October 1962, seated 44 to 56 passengers, but the VVS and Soviet Government departments bought a small number of 36-seat Tu-124K transports, with a 24-seat main cabin, eight-seat centre cabin and four-seat VIP forward cabin, as well as the Tu-124K2 with VIP seating throughout for a total of 22. These aircraft all remain in use for short/medium-range official transport, though very few Tu-124s remain with civil airlines. So far as is known the larger Tu-134 and -154 are not used by the Soviet armed forces.

Above: A civil Tu-124 with Interflug of East Germany.

Tupolev Tu-134

Tu-134, -134A (Crusty)

Origin: The OKB named for Andrei N. Tupolev; production assembly at Kharkov.
Type: Passenger transport.
Engines: Two 14,990lb (6,800kg) Soloviev D-30 or D-30 Srs II turbofans.
Dimensions: Span 95ft 1¾in (29.0,m); length (134) 114ft 8in (34.9m), (134A) 121ft 6½in (37.05m); height 30ft 0in (9.14m); wing area 1,370sq ft (127.3m²).
Weights: Empty (134) 60,500lb (27.5t), (134A) 64,045lb (29,050kg); loaded (134) 99,206lb (45t), (134A) 103,600lb (47t).
Performance: Maximum cruising speed 550mph (885km/h); normal cruise 466mph (750km/h); service ceiling 39,000ft (11.9km); range (134 with max payload of 16,980lb, 7.7t) 1,491 miles (2,400km), (134A with max payload of 18,075lb, 8.2t) 1,174 miles (1,890km).
Armament: None.
History: First flight (as 124A) 1963, (134A) about 1968.

Today the most widely used Soviet-built airliner on European routes, the Tu-134 was originally designated Tu-124A and used major portions of the earlier machine. Important differences were location of the engines on the rear fuselage, a T-tail and a general increase in size and power, the fuselage being stretched to seat 64-72 passengers in regular airline use. Though quite a 'hot' swept-wing jet, with takeoff and landing field length well over 2km (actual figures are 7,875ft/2.4km and 7,218ft/2.2km, respectively), a large bogie on each main leg spreads the load for soft airstrips, and a gas-turbine APU (auxiliary power unit) and other features make the aircraft independent of ground services. Airline service began in September 1967, by which time deliveries had begun to four Warsaw Pact air forces: Bulgaria (at least one), East Germany (two), Hungary (two) and Poland (two). All use the Tu-134 as the principal government VIP transport for major journeys within Europe, and occasionally in the Soviet Union. Curiously the Tu-134 has never appeared in VVS or AVMF service, though at least one of the Aeroflot civil examples is equipped as a VIP transport with luxurious seating for 15 to 20 passengers. The Tu-134A, in service from 1970, has a longer fuselage seating (typically) 84, and many other changes including Series II engines with reversers (in longer cowls) and pneumatic starters. Many late-production examples have a weather radar instead of a glazed navigator compartment in the nose. None is known to be in military service.

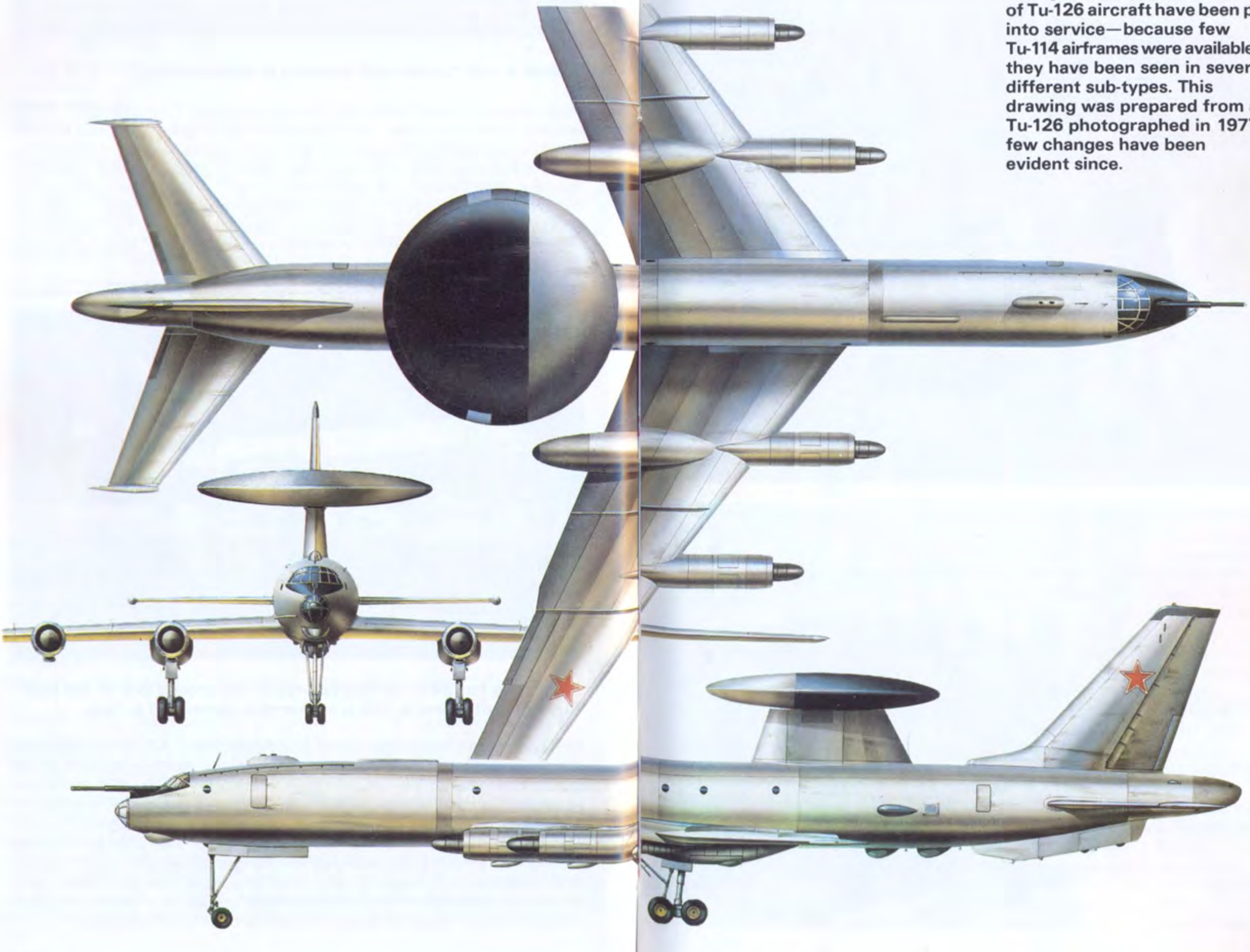
Right: The Tu-134 in various sub-types has proved one of the best Russian civil jetliners; this is an Aeroflot scheduled arrival.

Tupolev Tu-126

Tu-126

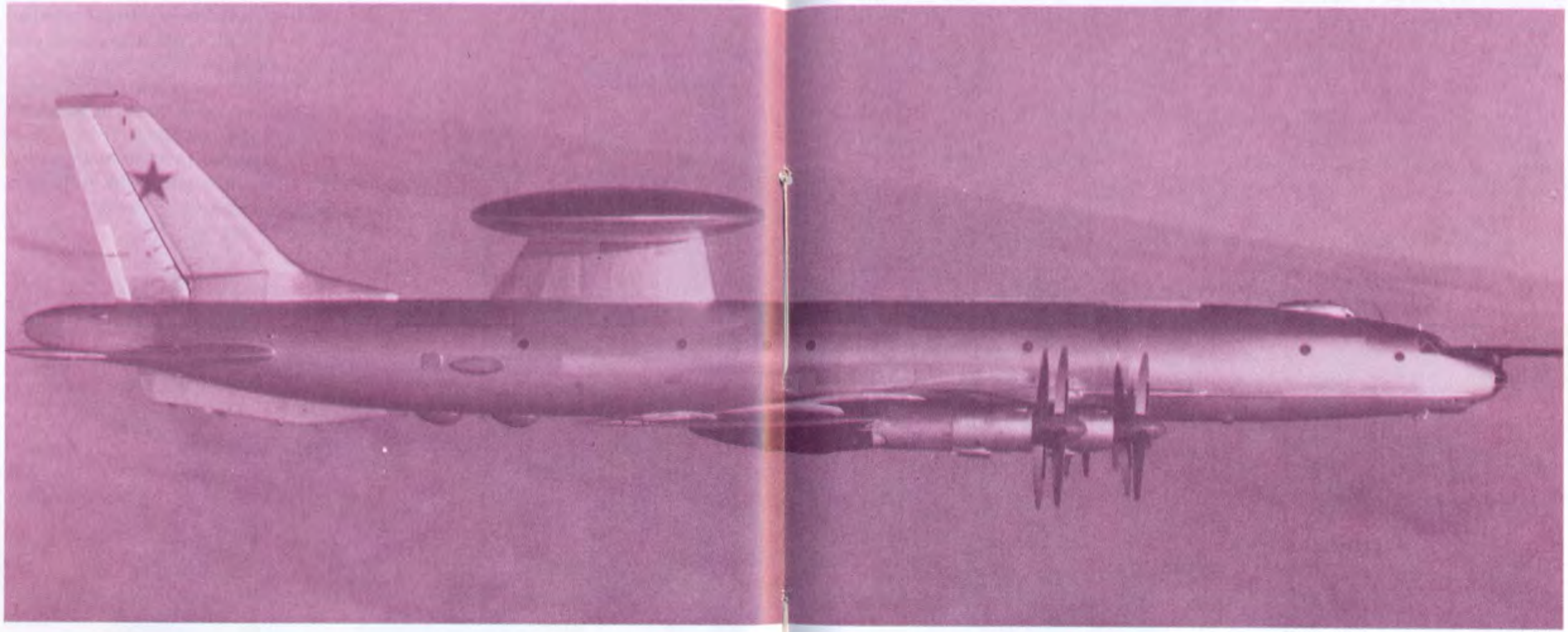
Origin: The OKB of Andrei N. Tupolev.
Type: Awacs-type surveillance and control.
Engines: Four 15,000ehp Kuznetsov NK-12MV turboprops.
Dimensions: Span 168ft 0in (51.2m); length overall 181ft 1in (55.2m); height 52ft 8in (16.05m); wing area 3,350sq ft (311m²).

Weights (estimated): Empty 200,000lb (90t); loaded 375,000lb (175t).
Performance: Maximum speed (36,000ft/11km and above) about 460mph (740km/h); patrol speed 320mph (515km/h); service ceiling 39,400ft (12km); unrefuelled max range 7,800 miles (12,550km); max endurance 24 hours.
Armament: None.
History: First flight (as 126) probably 1965; service entry, probably 1967. ▶



Though a relatively small number of Tu-126 aircraft have been put into service—because few Tu-114 airframes were available—they have been seen in several different sub-types. This drawing was prepared from a Tu-126 photographed in 1977; few changes have been evident since.

▶**Development:** First seen in a ciné film released in 1967, this aircraft was the first airborne surveillance and control platform to be developed in the Soviet Union, and it was a conversion of a former civil passenger airliner using almost the same wing, propulsion and other parts as the 'Bear' family of military aircraft. The Tu-114 is in fact slightly larger than the 'Bear', with a dramatically bigger fuselage and extended-chord wing flaps, and offered outstanding qualities of range, endurance and accomodation for the generating plant, radar, operator consoles, communications, aerials and crew rest facilities. The rotating radome is closely similar in geometry to that of the American E-3A Sentry, and other features include an FR probe, 21 visible avionic blisters or flush aerials, a large ventral fin used for various services, and an extended tailcone with further avionics. Called 'Moss' by NATO, these aircraft have been in service about 15 years and certainly represent an earlier state of the art than USAF, USN and RAF surveillance platforms, though the US assessment of 'ineffective' over land and 'only marginally effective' over water is misleadingly unhelpful. In many exercises, including the Indo-Pakistan war of 1971, the Tu-126 has gained enough experience not only to underpin the next generation but also to fly vital patrols in particular sensitive areas where interceptors and other aircraft, not only of the PVO, need airborne control. Only about 15 airframes were available; if they have no life problem they may be progressively updated and remain in service for many years.



Above: This photograph was taken by an aircraft of the US Navy in October 1972, and was one of the first high-quality illustrations of this type to become available in the West. Compared with the APY-1 radar of the Boeing E-3A Sentry the radar of the Tu-126 is relatively unsophisticated and is thought in the USA to be almost ineffectual over water. The aerial rotodome is deep but of limited diameter, and it is considered that the turboprop propulsion must cause annoying radar reflections as well as serious low-frequency vibration that could affect radar accuracy. It is doubtful that Western analysts have positively identified the function of all the 21-odd avionic aerials and blisters, the large ventral blister being visible in the later air-to-air picture at left. Though the Western assessments of the Tu-126 have almost certainly been unjustifiably jaundiced, the aircraft was never intended as more than a rather long-term stop-gap until a properly designed surveillance aircraft (based on the Il-76) could be put into use.

Tupolev Tu-128

Tu-28P and Tu-128

Origin: The OKB of Andrei N. Tupolev.
Type: Long-range interceptor.
Engines: Two afterburning turbojets, almost certainly Lyul'ka AL-21F-3 with max afterburning rating of 24,250lb (11t).
Dimensions (estimated): Span 60ft 0in (18.1m); length 89ft 3in (27.2m); height 23ft 0in (7m); wing area 860 sq ft ($80m^2$).
Weights (estimated): Empty 54,000lb (24.5t); internal fuel 30,000lb (13t); loaded 88,000lb (40t).
Performance (estimated): Maximum speed (36,000ft/11km), (clean) 1,200mph (1,900km/h, Mach 1.8), (4 AAMs) 1,090mph (1,755km/h, Mach 1.65); initial climb 25,000ft (7.5km)/min; service ceiling 60,000ft (18.3km); combat radius 777 miles (11,250km); ferry range 2,000 miles (3,200km).
Armament: Four 'AA-5 Ash' AAMs.
History: First flight 1959; service delivery, probably 1963-64.

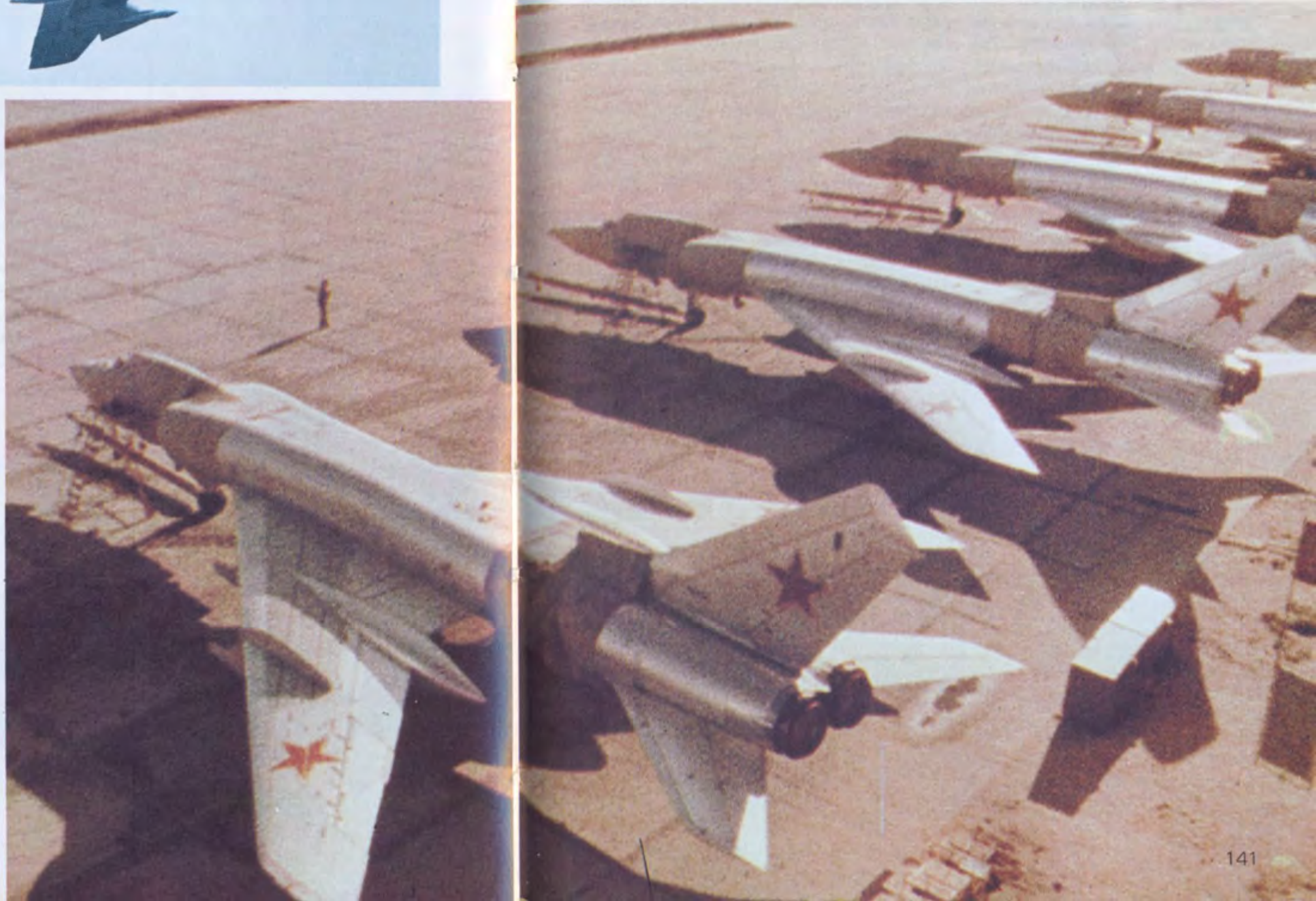
Development: Derived from the Tu-98 supersonic attack bomber, the Tu-102 was intended as a multi-role attack, reconnaissance and long-range interceptor, with a variety of weapons (including two of the large new 'AA-5' missiles) and a radar of unprecedented size (called 'Big Nose' by NATO). ▶

Right: Three-view of a standard Tu-128, still the largest type of fighter ever put into combat service. In close combat it would be almost defenceless, but the 'Big Nose' radar and 'AA-5 Ash' missiles confer kill capability over ranges of up to about 30 miles (48km).

▶After prolonged development the aircraft was reconfigured as the Tu-128 single-mission long-range all-weather interceptor, larger than any other fighter in the world and armed with two pairs of 'AA-5' missiles, two with IR homing and two with semi-active radar homing. The service designation of Tu-28 had already been allocated, and it was retained with the suffix P (perekhvatchik, interceptor), fighters normally having odd service numbers. Its Western reporting name is Fiddler. About 300 were built, of which 130-odd remained in PVO service at the start of 1982, the number slowly decreasing. Soviet philosophy of never throwing anything away means that nobody should be surprised to see these aircraft updated with major changes in engines, weapons or even swing-wings, though there is as yet no evidence of this and the airframe may have a lift problem.

Right: Frame from a ciné film showing takeoff of a Tu-128 carrying missiles on the inboard pylons only. Gear retraction appeared slow.

Above: This is the original Tu-28 (OKB designation Tu-102) which was publicly displayed in 1961. The basic airframe was the same as that of today's long-range interceptor.



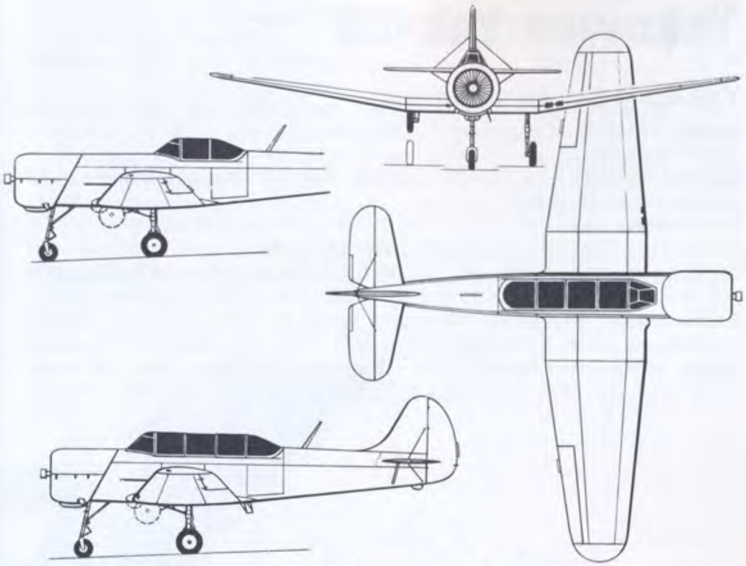
Right: Tu-128 'Fiddler' interceptors at readiness, though with canopies shut and dark sheets spread over the cockpits, inlets and engine bays, and with large blanking caps in the engine nozzles. It may be that this base is subject to severe dust or sand storms? With a length of 85ft (26m) these aircraft need vast areas of apron, as well as runways much longer than those of FA aircraft.

Yakovlev Yak-18

Yak-18, 18A and 18PM

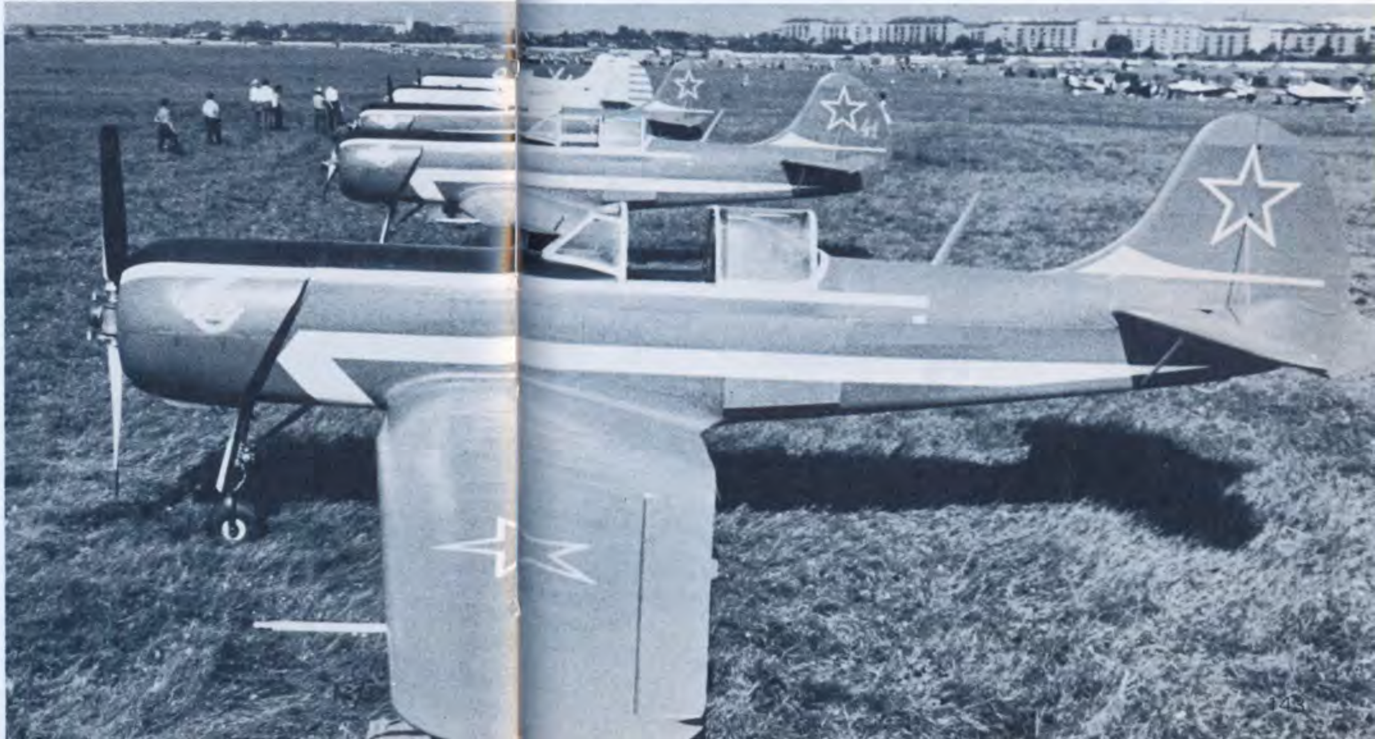
Origin: The OKB of Aleksandr S. Yakovlev.
Type: Pilot trainer (PM, aerobatic trainer).
Engine: One aircooled radial piston engine: (18) 160hp M-11FR five-cylinder, (18A) 260hp AI-14R 9-cylinder (18PM) 300hp AI-14RF.
Dimensions: Span 34ft 9½in (106m); length (18) 26ft 6in (8.1m), (A, PM) 27ft 5in (8.354m); wing area 182.9sq ft ($17m^2$).
Weights (typical): Empty (18) 1,800lb (816kg), (A) 2,238lb (1,025kg); loaded (18) 2,469lb (1,120kg), (A) 2,901lb (1,316kg), (PM) 2,447lb (1,110kg).
Performance: Maximum speed (18) 154mph (248km/h), (A) 165mph (266km/h), (PM) 199mph (320km/h); time to climb to 3,280ft (1km), (18) 5min, (A) 3.3min, (PM) 1.7min; service ceiling (18) 13,120ft (4km), (A) 16,600ft (5.06km), (PM) 23,000ft (7km); range (18) 630 miles (1,015km), (A) 440 miles (710km), (PM) 250 miles (400km).
Armament: None.
History: First flight (18) 1946, (A) 1957, (PM) 1965.

Development: Still by far the most numerous primary pilot trainer in the Soviet Union, the Yak-18 family can trace its ancestry straight back via the UT-2MV to the UT-2 (Ya-20), the standard primary trainer in World War 2 which flew in May 1935. All have been tough but simple low-wing monoplanes with a fuselage mainly of welded steel tube and wings and tail of aluminium alloy, with metal skin over the leading edges and fuselage back to the rear cockpit and fabric elsewhere. The Yak-18, with a helmeted engine cowl, introduced full blind-flying instruments, sliding transparent hoods over the tandem cockpits and pneumatically operated retractable landing gear and flaps. In 1957 the Yak-18A introduced a cleaned-up airframe, a more powerful engine in a smooth long-chord cowl driving a controllable-pitch propeller, and retractable tricycle landing gear. Special aerobatic variants in the 1960s included the PM, used by the armed forces, with even more power, a single central cockpit and inwards-retracting main gears. By 1968 a total of 6,760 Yak-18s had been built, of which about 1,800 were used by Soviet military schools. The Yak-18T multi-role four-seater, still in production, is also used by the VVS in small numbers.



Above: Three-view of the widely used Yak-18A trainer (with part-retracting landing gear) and extra side view of single-seat Yak-18P.

Right: No aircraft better illustrates the Soviet philosophy of progressive improvement than the Yak-18, whose ancestry can be traced back step by step to the famous UT-2 of 1935. One of the many special versions was the Yak-18PM single-seater, which won the 1966 World Aerobatic Championships. These three have VVS markings; two USSR Team aircraft in the background have the white and red-strip livery of the Yakovlev OKB. Today the same family has resulted in the Yak-50 aerobatic machine and the Romanian-built Yak-52 trainer of the VVS.



Yakovlev Yak-28

Yak-28 in eight variants

Origin: The OKB of Aleksandr S. Yakovlev.
Type: See text.
Engines: (Most) Two 10,140/13,670lb (4.6/6.2t) thrust Tumanskii R-11 afterburning turbojets.
Dimensions: Span (most) 41ft 0in (12.5m); length overall, from 71ft 0in (21.6m) to (28P) 75ft 0in (22.9m); wing area 405sq ft (37.6m^2).
Weights (estimated): Empty (28U) 23,000lb (10.4t), (28P) 29,000lb (13.15t); maximum loaded (28U) 33,000lb (15t), (28P) 44,000lb (20t).
Performance (estimated): Maximum speed (hi, typical, clean) 750mph (1,200km/h Mach 1.14), (SL) 646mph (1,040km/h, Mach 0.85); service ceiling (afterburner) 55,000ft (16.75km); combat radius (all-hi) 560 miles (900km); ferry range 1,550 miles (2,500km).
Armament: (Most) none, (28P) two 'AA-3 Anab' and two 'AA-2-2 Advanced Atoll' AAMs.
History: First flight (28) about 1959, (28P) about 1960.

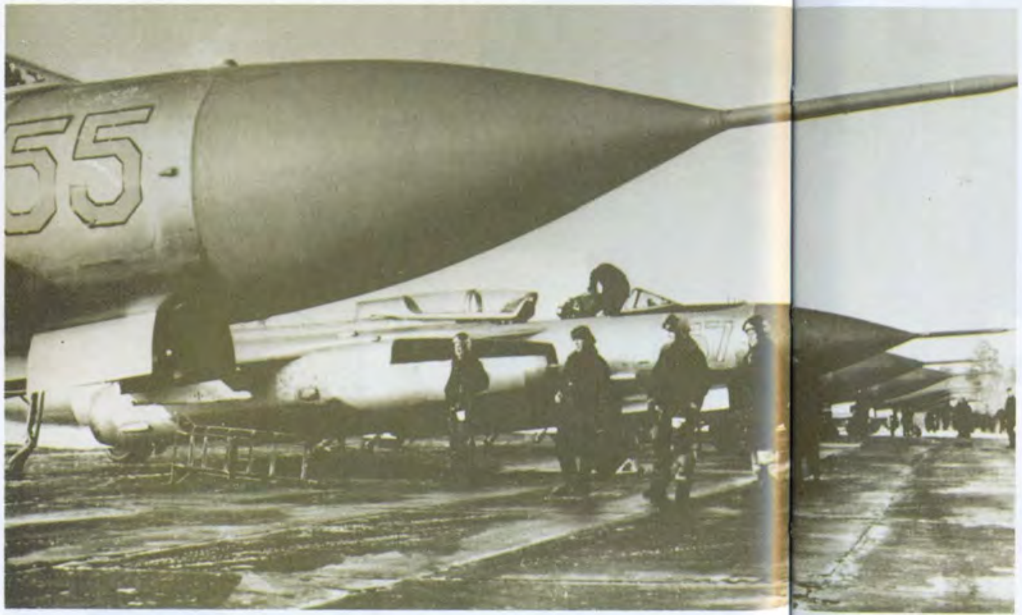
Development: Yakovlev started a completely new family of twin-jet military aircraft by winning the first competition for a dedicated radar-equipped night interceptor over the La-200B in 1952. The resulting aircraft, with service designation Yak-25, had a long life and after withdrawal from PVO regiments saw further service as trials, RPV, high-altitude reconnaissance▶

Below: Three-view of a Yak-28 of the 'Brewer-E' family, used as a high-power tactical jammer and EW aircraft. All are rebuilds.

▶and other forms, many of which are still flying. Via various Yak-26 and -27 variants the Yak-28 family emerged late in the 1950s with R-11 afterburning engines and a largely new airframe tailored to increased weights and speeds. The profusion of variants was reflected in six NATO code names, most variants having a navigator in a glazed nose, an internal weapon bay and being called Brewer. Most survivors are EW/ECM platforms, the most important being 'Brewer-E' with a pointed nose containing a large active jammer radiating via aerial faces replacing the navigator's nose windows in other versions. 'Brewer-C' is believed still to be in use in minor geographical areas, with a fixed 30mm gun and bomb bay for 4,400lb (2t) of ordnance, while 'Brewer-D' is a multi-sensor reconnaissance variant of which some 175 were serving in 1981. A rather larger number of Yak-28P ('Firebar') all-weather interceptors are still in combat service with the PVO in secondary areas, packing almost the same engines, radar and weapons as the Su-15 into an older and much slower airframe. The Yak-28U trainer, with added front (pupil) cockpit, has the NATO name 'Maestro', and is one of a related family with various differences including shorter engine inlets.

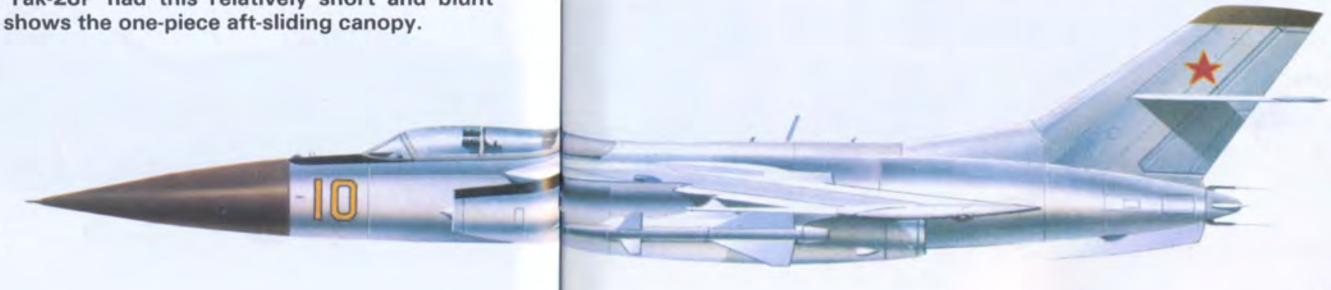
Right: A line up of Yak-28 series aircraft of 'Brewer-C' type, with nose-compartment roof hatches open for the navigator/bombardier.

Below right: The Yak-28U trainer version has two individual single-seat cockpits in tandem, each with its own canopy.



Above: The original Yak-28P had this relatively short and blunt radome. This picture shows the one-piece aft-sliding canopy.

Right: Profile of a later 28P with the longer and more pointed radome. The missile is an 'AA-3 Anab', two of which are carried.



Yakovlev Yak-36MP

Yak-36MP Forger-A and (36U) -B

Origin: The OKB of Aleksandr S. Yakovlev.
Type: Ship-based VTOL strike/fighter.
Engines: Vectored-thrust turbofan(s) or turbojet(s) with total takeoff thrust of about 16,500lb (7.5t); two lift jets ahead of wing with thrust of about 7,700lb (3.5t) each.
Dimensions (estimated): Span 24ft 0in (7.32m); length (A) 50ft 0in (15.24m), (B) 58ft 0in (17.68m); wing area 170sq ft (15.8m²).
Weights (estimated): Empty (A) 16,000lb (7.25t), (B) 17,650lb (8t); maximum loaded (both) 23,700lb (10.75t).
Performance (estimated): Maximum speed (hi, clean) 725mph (1,170km/h, Mach 1.1), (SL, clean) 700mph (1,125km/h, Mach 0.9); initial climb, Western figure of 14,750ft (4.5m)/min appears rather low; service ceiling about 40,000ft (12.2km); combat radius (attack mission, hi-lo-hi) 230 miles (370km); ferry range (4 tanks) 1,800 miles (2,900km).
Armament: All carried externally on four pylons, total load estimated at 3,000lb (1,360kg).
History: First flight (prototype) possibly 1971; service delivery, possibly 1975. ▶

Below: Three-view of a Yak-36MP which operated aboard *Kiev* during the ship's first ocean cruise in summer 1976. Four 'Atoll' AAMs shown.

▶**Development:** First Soviet fixed-wing aircraft designed for shipboard use since the KOR-1 biplanes on cruiser catapults, the Yak-36MP is a twice-removed descendant of the Yak-36 'Freehand' VTOL research aircraft demonstrated in 1967. This earlier machine had two turbojets side by side in the bottom of the tadpole-like fuselage exhausting through left/right vectored nozzles. The 36MP, the result of prolonged testing reported to have included the flying of several dissimilar prototypes, follows the same formula but adds two lift jets in the near-vertical position ahead of the wing, between the main inlet ducts. This enables the lift/cruise engine to be smaller, but precludes STOL takeoff or the use of a ski-jump deck; and thus greatly restricts the mass of external stores that may be uplifted. The lift jets are thought to be from the Koliesov OKB and have a thrust variously estimated by Western commentators between 4,400 and 8,800lb each Doors cover the lift-engine bay in translational flight, and there is no evidence that the lift-jet nozzles can be vectored to assist accelerating or decelerating transitions, which respectively involve a pronounced nose-down attitude and the use of large wing flaps and possibly slight forward vectoring of the two main nozzles.

The latter are plain circular nozzles unlike the cascade-fitted nozzles of the Harrier family. There is uncertainty over whether they are both served by a single large engine. The official view in the West is that this is the case, and some observers have even identified the main engine as a Lyul'ka (said to be 'a version of the AL-21') because in some conditions it has left visible smoke. Use of a single large engine would cause severe problems in the wing-spar carry-through structure, changing the engines and several other respects, besides marking an un-Russian departure from the original Yak-36 formula. Be that as it may, the Yak-36MP has impressed observers with its rock-smooth VTOL missions from the large multi-role ships *Kiev* and *Minsk*, strongly suggesting electronic guidance from the ship. MP could well stand for the Russian for Marine Interceptor, and the primary mission is believed to be the destruction of NATO aircraft, under guidance from the parent vessel. Gun pods and various AAMs can be carried on the four pylons under the small folding wings, though in the 1981 US official review *Soviet Military Power* one sentence on this aircraft–known as 'Forger-A'–read 'it can be fitted with short-range air-to-surface missiles, rockets or bombs for use against ship or shore targets', suggesting that the elimination of such aircraft as the P-3, S-3 and Nimrod may be secondary. Most examples seen since 1980 have additional dielectric areas and there is certainly comprehensive navigational and EW equipment, but no radar other than a small ranging sight and no visible sensor such as a FLIR or laser receiver. It is known that 'AA-2-2 Advanced Atoll' can be carried, but one Western writer states that the much more sophisticated 'AA-8 Aphid' can also be fired.

A typical maximum complement for each of the four ships of *Kiev* type is considered to be 15 'Forgers' including perhaps three of the rather crudely contrived 'Forger-B' dual trainer version, which has a much longer front and rear fuselage, no ranging radar and (in examples seen by 1982) no pylons. The Yak-36MP is generally regarded as an interim aircraft, with obvious severe limitations, but it has already proved valuable in flying hundreds of simulated attack and interception missions at sea, preparing the ground for a more formidable successor able to make STOL takeoffs from the angled decks of the four large ships.

Above: A single-seater approaches *Kiev's* flight deck. The louvered lift-engine door is open and the flaps lowered (they remain at this angle when the aircraft is parked).

Right: Single-seaters parked aboard *Minsk* in 1978. The deck receptacle provides electric power, but there do not appear to be any tie-down points—merely conventional chocks.

Air-launched Missiles

Early generations of Soviet AAMs (air-to-air missiles) and ASMs (air-to-surface missiles) were notable mainly for their large size and weight, which was usually not related to significantly greater range than smaller Western missiles. More recent Soviet air weapons have been extremely competitive.

Air-to-Air Missiles

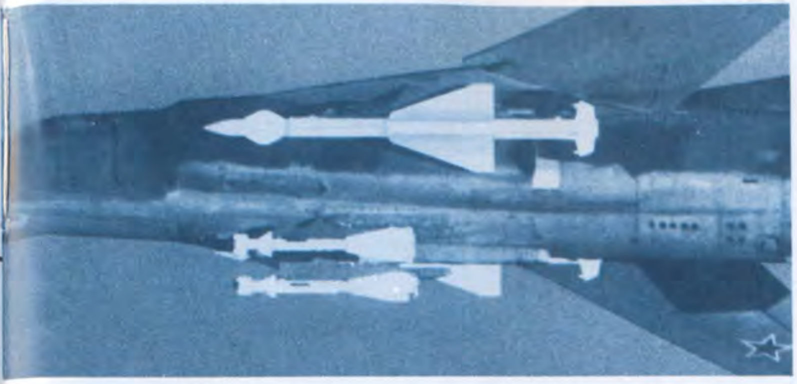
Apart from the K-13 series, with NATO designation 'AA-2A toll', which were originally a direct copy of the American Sidewinder, most Soviet missiles in this category have been highly original. Almost all have been developed in both IR-homing and radar-homing versions which are carried in pairs by each interceptor to give the greatest lethality under any kind of weather or electronic environment.

AA-1 Alkali

The first Soviet production AAM, this unusual missile has cruciform foreplanes and rear delta wings indexed in line, and is guided by either 'Scan Odd' or 'Spin Scan' interceptor radars. It was standard armament on the MiG-19PFU and PFM, Su-9 and certain other early all-weather fighters, but is no longer in front-line duty.

AA-2 Atoll

This close-range missile was a direct copy of the AIM-9B Sidewinder, and has even smaller body diameter. The original series model, designated K-13A, was built in IR and radar versions with slightly different noses. At least 50,000 were delivered, used on almost all early MiG-21s and many other aircraft, in later installations with the IR seeker cooling system housed in the launch pylon. The 'AA-2-2 Advanced Atoll' is a generation dating from about 1970, again in IR and radar versions and with improved canard controls and, in the latest IR version, with an all-aspect seeker.

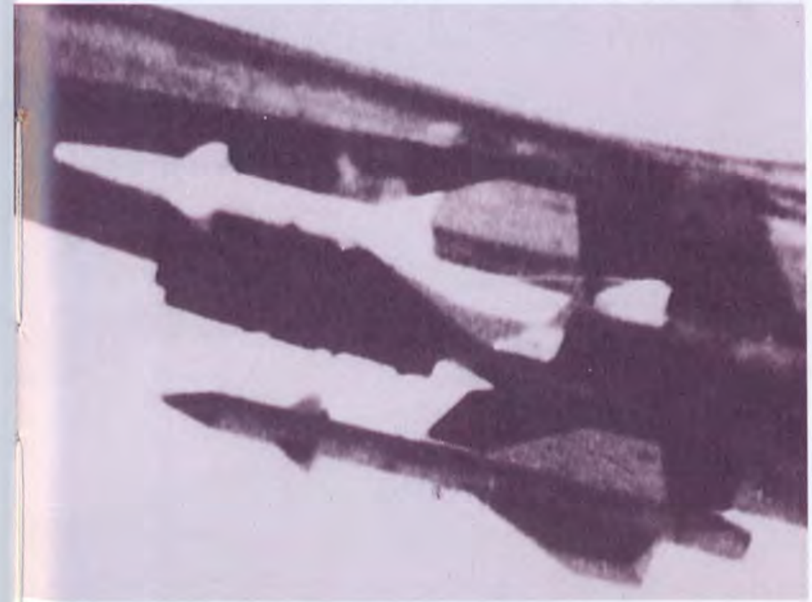


Above: Released in mid-1981 this is the best available photograph of the AA-7 Apex (on Mig-23MF glove pylons) and AA-8 Aphid (belly).

AA-3 Anab

At first (1961) thought by Western analysts to be an ASM, this was the first powerful long-range AAM to reach the PVO and it has for many years been deployed in various versions on the Yak-28P, Su-11 and Su-15. All early versions were linked in the radar variant with the Skip Spin radar, the guidance driving canard controls indexed in line with the large rear cruciform wings. In 1972 Western sources identified an 'AA-3-2 Advanced Anab', details of which have not been published. ▶

Below: A pair of 'AA-3 Anab' AAMs carried by an Su-15 'Flagon'; the radar-guided variant is slightly shorter, despite its pointed nose.



Left: Standard armament of the Tu-128 is four of the large 'AA-5 Ash' AAMs. Usually two pointed-nose radar-homing missiles are carried outboard and two IR-homing missiles (slightly longer) inboard.

AA-4 Awl

Large long-range missile carried by MiG Ye-152; not produced in series.

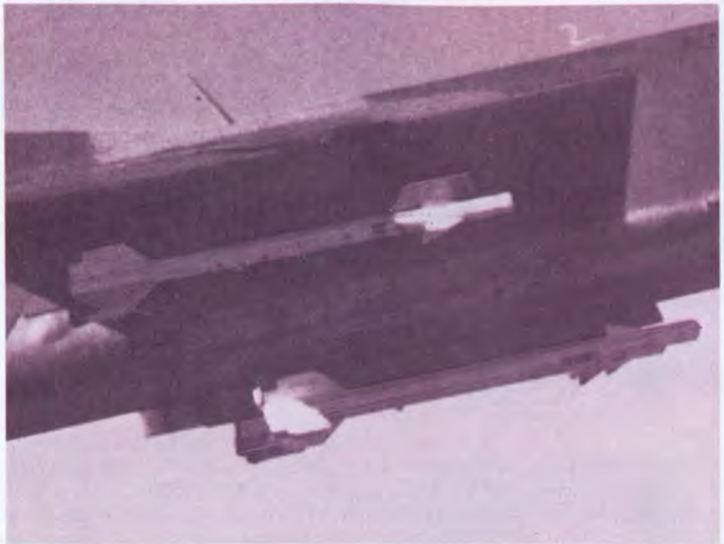
AA-5 Ash

This was the largest AAM in service in the world during the period 1961-75, as standard armament of the Tu-28P. Fitted with very large delta wings indexed in line with rear control fins, it was built in both IR and radar versions, the latter associated with the very large Big Nose I-band radar. Two pairs of these weapons have for 20 years been standard armament of the Tu-28P and they are also commonly carried by the MiG-25, especially on training sorties in which missiles are expended.

AA-6 Acrid

Largest AAM in service in the world, this was developed in the early 1950s to arm the MiG-25 and has been developed in an IR homing variant, with a seeker head of great sensitivity, and in a radar variant associated with the Fox Fire and wingtip-mounted CW illuminating radar. Though a canard this missile has hardly anything in common with AA-3 Anab and has rolling ailerons on rear delta wings supplenenting the delta canard control surfaces. Western analysts claim that the version with a conical nose is the radar model and that with a much longer rounded nose is IR guided; this is the opposite of what one would expect. Pointed-nose missiles are carried on the MiG-25 outer pylons, the other type being on the inboard pylons.

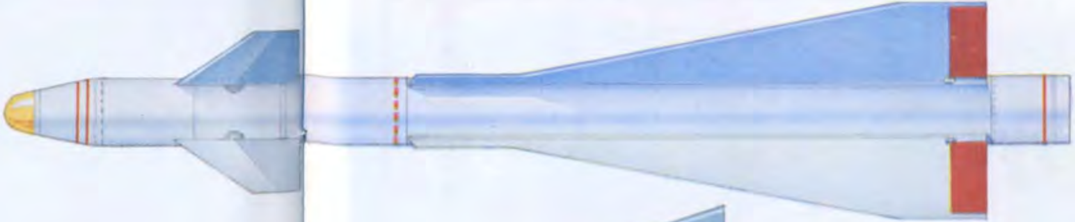
Above and right: The world's fastest interceptor, the MiG-25 normally carries four AAMs on its wing pylons, of various types. At first 'AA-5 Ash' was seen; later the usual load was four of the giant 'AA-6' type as pictured above, and now a common load is two 'AA-8' (right) plus two 'AA-7' (below).

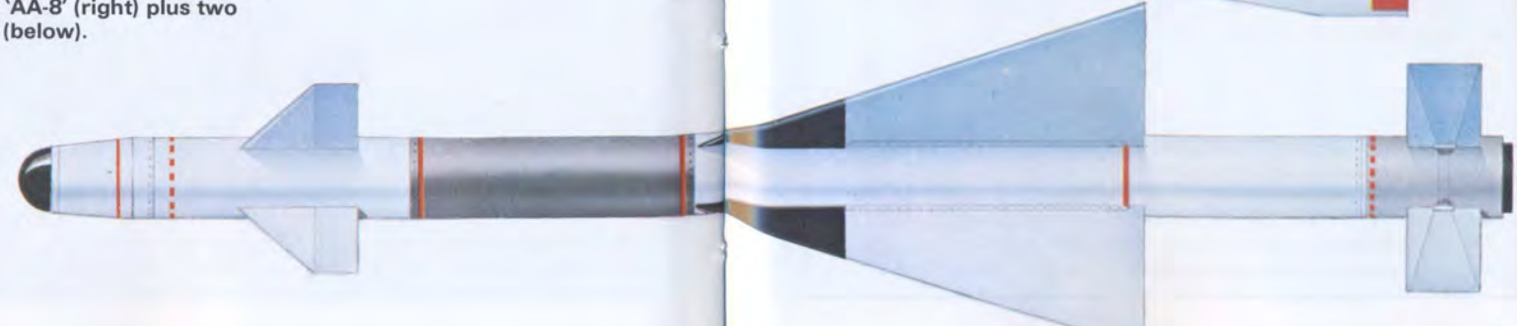


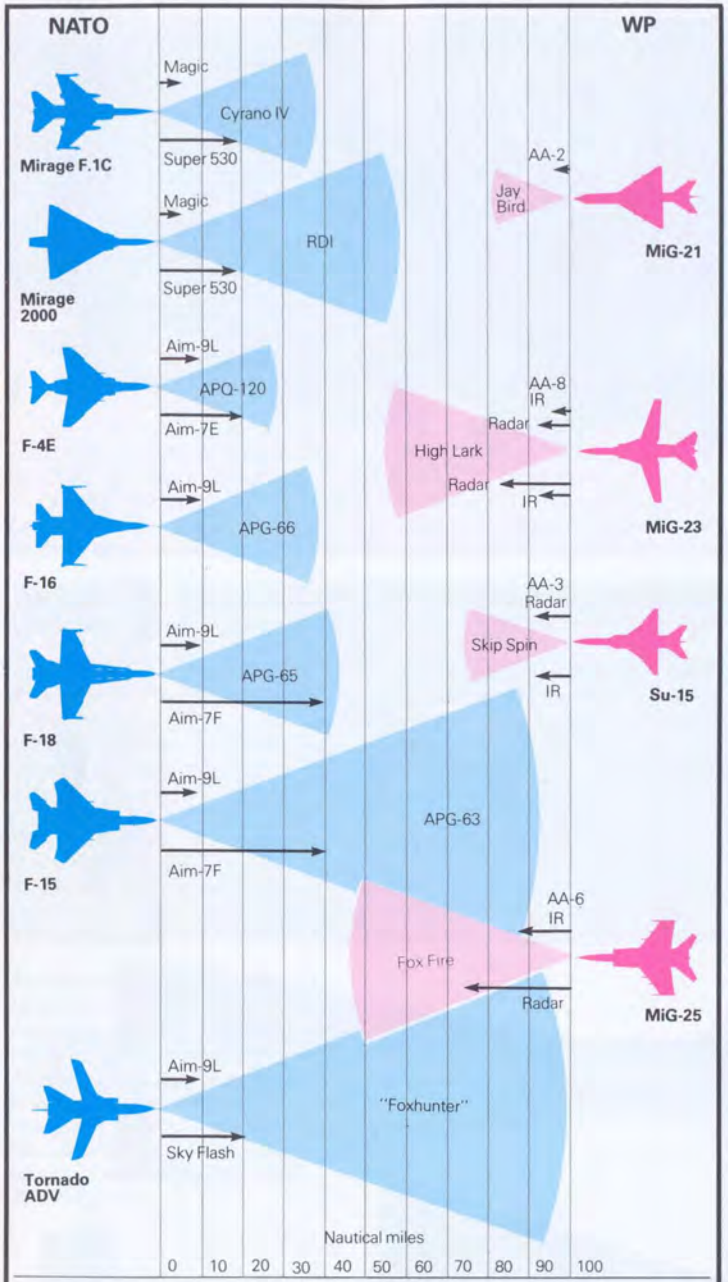
Above: Like the West's Sidewinder, from which it was derived, the AA-2 Atoll close-range AAM (here on Libyan MiG-23) is widely used.

AA-7 Apex

Standard medium-range AAM on all new Soviet all-weather interceptors, this substantial weapon has a unique aerodynamic configuration with centrally mounted delta wings, canard controls on the forward guidance section and four rear rectangular fins (believed also to be driven by the control system) around the motor nozzle. This could result in enhanced turn radius in air combat and there is no reason to doubt that this weapon is superior to any air-combat AAM available to the West except Sky Flash, which is handicapped by 25-year-old aerodynamics. AA-7 exists in radar and IR versions, the former matched with both High Lark radar in the MiG-23MF and with certain versions of MiG-25 which are reported to carry this missile on their outer pylons. AA-7 is carried by the Mig-23MF on the glove pylons.







Above: This diagram is based on purely Western assessments of Soviet missile and radar performance, and there is some evidence the ranges shown are underestimates—by a very wide margin in the case of the radar and AAMs of the MiG-25. Nevertheless, it is beyond doubt that Soviet AAM and radar technology has in the past lagged that of the West.

AA-8 Aphid

Standard close-range AAM of all Soviet fighters, this neat and apparently very formidable weapon has large rear delta wings giving good manoeuvrability even up to extremely high altitudes, with delta canard controls indexed in line and small rectangular fins around the guidance receiver in the nose. Both IR and radar versions are believed to exist, though only the former has been positively identified on the MiG-21, MiG-23 (all versions), Yak-36MP and other types.

AA-X-9

This is believed to be a successor to AA-6 Acrid, possibly using similar aerodynamics and controls, with 'look-down Shoot-down' guidance effective against low-flying targets (for which purpose AA-6 is thought in the West to be ineffective, though this must have been a prime design objective).

Air-to-Surface Missiles

Soviet ASMs include the largest air-launched guided missiles in the world, most of them being of aeroplane-type configuration and with various forms of propulsion. So far no long-range supersonic rocket missile in the class of SRAM had been identified by the West, nor a modern air-breathing folding cruise missile, though prototypes in both classes have probably been tested.

AS-1 Kennel

The first Soviet ASM produced in series, this MiG vehicle was a large air-breather carried by an early variant of Tu-16 but withdrawn before 1981.

AS-2 Kipper

Powered by an underslung turbojet, this large transonic missile strongly resembles the withdrawn USAF Hound Dog, but is used as an anti-ship weapon with beam-riding, programmed mid-course and terminal homing (IR and possibly also radar) guidance. Nuclear or large conventional warheads are used. The missile is carried under the fuselage of the Tu-16 'Badger-C'.

Below: An Egyptian Tu-16 'Badger-G' in a ceremonial flypast with its two AS-5 Kelt anti-ship missiles hung under the wings.

AS-3 Kangaroo

Largest ASM known, this again has an aeroplane-type configuration, with wings superficially similar to those of the MiG-19. It is carried under the fuselage of the 'Bear-B', with the nose inlet faired in by a retractable curved fairing which is raised prior to starting the missile's turbojet engine. Large conventional or nuclear warheads are carried, and in this case operation against moving (ship) targets is not thought possible, inertial or preprogrammed autopilot guidance being thought more likely.

AS-4 Kitchen

This important supersonic missile was first seen under the fuselage of 'Blinder-B' in 1961, and is today carried in considerable numbers under these aircraft, Tu-16 'Badger-C' and -G and about half the 'Backfire-B' force in the AVMF. The large but finely streamlined fuselage has a long ventral spine and rides on very slender delta wings, the tail being a cruciform with the underfin hinged to the right for aircraft ground-clearance. Propulsion is believed to be by liquid rocket and guidance to combine a mid-course inertial phase with IR or some other homing method for use against ships. The warhead is normally nuclear.

AS-5 Kelt

The successor to AS-1 under the wings of Tu-16 bombers of the DA, this subsonic weapon has a similar airframe but a rocket propulsion system making possible the installation of a streamlined nose which is believed to house radar or some other form of homing guidance (following an inertial or programmed mid-course phase). About 25 were used against Israeli targets in 1973, at least two homing on to radar stations, but a number being shot down en route by F-4s. All are believed to have large conventional warheads and to be launched in pairs from 'Badger-G' carriers.

Below: The monster AS-3 Kangaroo, almost certainly a product of the MiG design bureau, was carried only by the Tu-20/142 'Bear'.

Below: A provisional drawing of the AS-6 Kingfish, a precision-guided long range missile carried by both the Tu-16 (Badger) and the much later Tu-22M (Backfire). Many of the latter type of aircraft have been seen with AS-4 (see upper right).

Above: A Tu-22M Backfire of the Soviet naval aviation with an AS-4 Kitchen supersonic missile recessed into its belly.

(Photo, Swedish Air Force).

AS-6 Kingfish

Closely similar to AS-4, this weapon has even better streamlining and is thought to cruise at Mach 3, making it virtually uninterceptable except by advanced computerized defences. The normal warhead is believed to be nuclear, with about 200kT yield. The main carriers are 'Badger-C' and -G aircraft of the AVMF, but it is also expected this weapon will be seen on 'Backfire'. The older bomber carries the missile under either or both wings, and they are thought to have homing guidance for use against ships (active radar has been suggested in the West) as well as fixed targets.

AS-7 Kerry

The unexplained omission from the FA inventory of a precision-guidance tactical ASM appears at last to have been ended by the issue of this substantial weapon to Su-24 regiments and possibly to units using other aircraft such as the Su-17 or MiG-27. It has been suggested in the West it has radio command guidance, but this is undoubtedly allied with a further system such as TV, EO or IIR.

AS-8

Reported 'fire and forget' missile carried by Mi-24 helicopters.

AS-X-9

Reported anti-radiation missile carried by Su-24.

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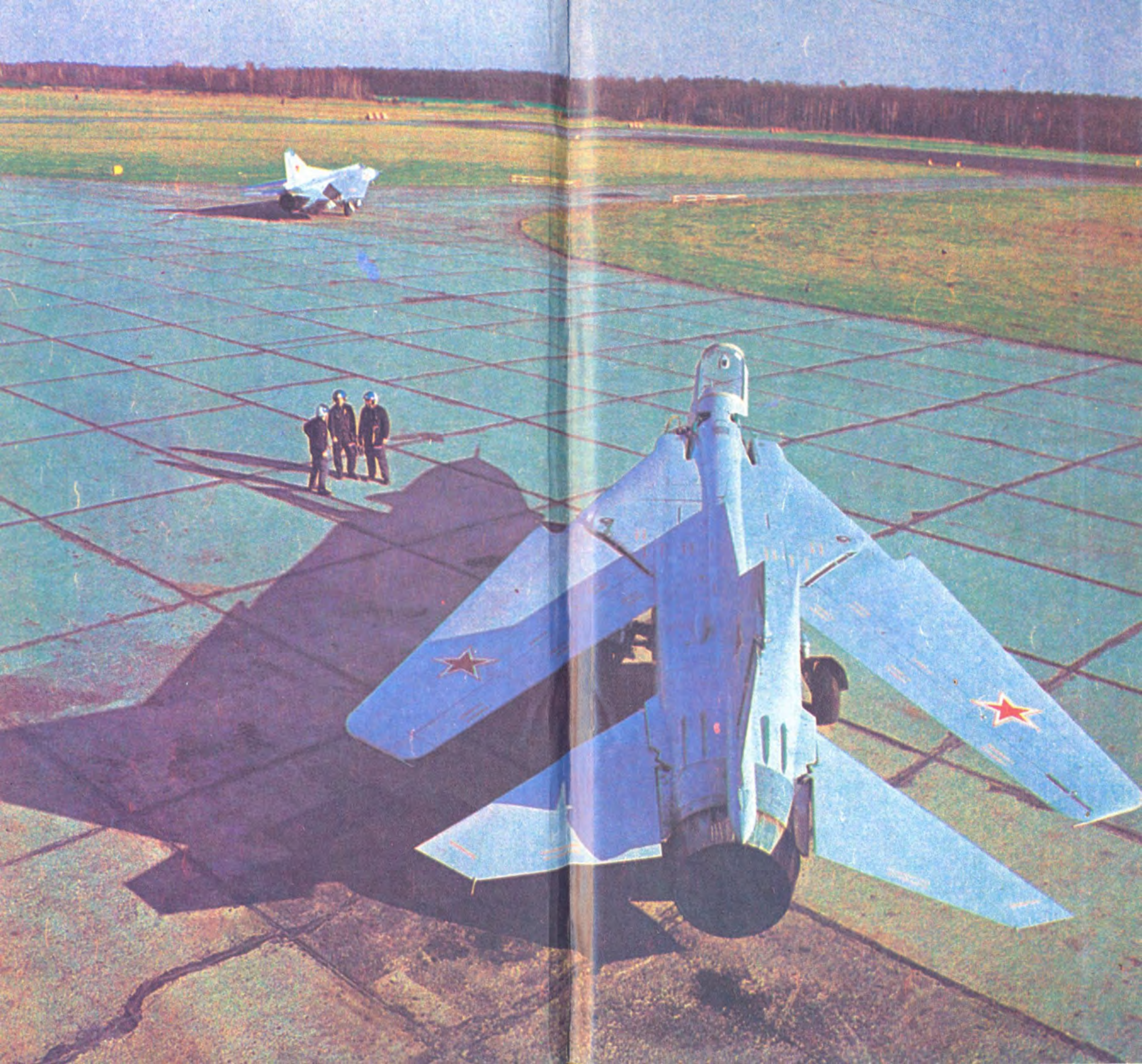

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